Wyoming School Facilities Commission

School Design Guidelines

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Introduction

The following document includes the Wyoming School Facilities Design Guidelines (referred to as the "Design Guidelines" in this document) developed for the Wyoming School Facilities Commission (referred to as the "SFC" in this document). This document is intended to be a guideline when designing schools in the State of Wyoming. The Design Guidelines assume that the district(s) has generated educational specifications, which further delineate the use of these guidelines. The Design Guidelines should not be used as the basis for developing the educational specifications.

These guidelines are intended to encourage innovative design for schools in Wyoming. Many of the guidelines use and encourage High Performance Standards for schools. It is the intent to develop and design schools that are safe, secure, and promote the best environment for learning.

This document includes the required guidelines for the design of new educational buildings and the remodel of educational buildings in the State of Wyoming. As noted, this document is a guideline and not a standard or construction specification; however, some design or construction standards are included in this document. The design or construction standards are highlighted in gray throughout the document and are associated with the terms "will" and "shall". In some instances, section headings are highlighted in gray. In these instances, the entire content under the highlighted section heading is a design or construction standard and shall be followed. In other areas of this document where guidelines are indicated they are to be understood as flexible and are associated with the terms "may" and "could". The design or construction standards indicated throughout the document are considered mandatory minimum requirements. More stringent requirements shall be used when required by the current State or locally adopted building codes.

As indicated throughout this document it is indicated that new construction must comply with the American Disabilities Act (ADA) guidelines. This is true for new educational buildings and renovated educational buildings.

Any addition or deviation from these guidelines may be considered an enhancement to the school and the cost associated with the enhancement may become the responsibility of the school district. All enhancements will be bid as alternates. A life cycle cost analysis must be completed on any alternative building system. Any deviation from the guidelines requires early approval from a SFC representative.

Throughout the design of a project, the school district and design team should value engineer each option considered. Value engineering is the process of weighing functionality versus cost. The function of a building system or a building design should balance with its cost.

Site Guidelines

The purpose of this section is to assist the school district and the design professional with selection, purchase, and/or development of a site.

1. Site Selection Criteria

At first look, a potential site may appear to be a good acquisition. There are many factors, however, that impact the suitability of the site. The following are factors to be considered for judging the merits of a potential site.

- Topography
- Vehicle access
- Soil characteristics
- Site utilities
- Site preparation
- Codes and zoning
- Adjacent property
- Easements/rights-of-way
- Environmental restrictions
- Aesthetic considerations

The following items should be primary considerations for the site selection and development. The SFC recommends that prior to purchasing a site, the district planner or architect prepare a site utilization plan to determine if the site is cost effective. Factors contained in the section should be used in the site utilization study.

a. Site Size

School site sizes are as follows (per the Rules and Regulations of the School Facilities Commission):

i. Elementary School

- Four acres of useable area with an additional acre for each 100 students. Very large design capacities will require additional space for building, parking, and play areas.

ii. Middle School

- Ten acres of useable area with an additional acre for each 100 students.

iii. High School

- Twenty acres of useable area with an additional acre for each 100 students.

Useable area is defined as the area of a site that can be used for a school building and school activities. For example, a large site can diminish if wetlands are to be avoided or if part of the area is in a floodplain.

b. Site Access (Ingress/Egress)

Access to and from the site, which has connection to a major highway or road artery, is an important factor in site access. Each school site must have at least two points of access. Schools should not be located directly adjacent to a major highway or high use arterial due to traffic safety. A traffic study may be required to predict the impact of the school at peak times of arrival and dismissal.

c. Site Topography

A reasonably level area is required to accommodate buildings, parking, student playgrounds, and physical education areas. Steep sites will require additional earthwork, retaining structures, or steep drives to accommodate development and should be avoided when possible.

There should be sufficient slope to allow for positive drainage to storm sewer outlets or other discharge points. Natural features should be retained as much as possible to provide a learning environment.

A site topographic survey is required for all sites. Do not develop facilities on land where the elevation is lower than two feet above the elevation of the 100-year flood as defined by the Federal Emergency Management Agency (FEMA).

d. Utilities

Adequate utilities should be extended to the site boundaries or readily available within a short distance of a proposed school site.

i. Storm Water

In most cases, storm water must be detained on-site and released at a rate that will not exceed current runoff rates and meet the requirements of the authority having jurisdiction for the site. Storm water systems are designed for a 10-year, 24-hour storm using a U.S. Soil Conservation Service (SCS) Type II storm hydrograph or per local jurisdiction requirement. Storm water systems should be checked to eliminate flooding for a 100-year storm event.

ii. Sewage

Sewage from school buildings will be discharged into an approved sewage system per applicable codes. On-site systems should be avoided and shall be approved by the SFC prior to acquiring the site.

iii. Domestic Water

Domestic water should be available in sufficient quantity for domestic, fire flow, and other school uses. A water flow test will provide data on the available water flow in gallons per minute (gpm), static pressure available,

and available residual pressure for fire protection systems. Water storage sufficient to meet the fire flow and duration requirements should be available.

If a local municipal water service is not available, an on-site well system is required. The on-site well system will be required to provide water for domestic use and fire protection systems. When a well is considered, a test well is to be drilled.

iv. Electrical Power

Electrical power is essential for the operation of a school. Power should be available on the school site or in close proximity of sufficient capacity for the proposed school. Three phase power is required.

v. Natural Gas

Natural gas may be needed for the site. The site design professional is required to evaluate the need and method to provide gas service to the building. If natural gas service is not available, the installation of liquid propane (LP) gas should be investigated.

vi. Other Utilities

Other utilities including telephone, cable television, and data are desirable but not completely required for site selection, unless completely unavailable within a reasonable means.

e. Subsurface Characteristics (Geotechnical Evaluation)

Aside from the surface characteristics, subsurface conditions require exploration. If there is a concern, preliminary soil borings or test pits (if applicable) should be taken to ascertain the presence of poor soils, high water tables, rock, voids, or other impediments prior to the property being acquired.

A Phase I Environmental Study is required prior to all property purchases/acquisitions. The Phase I must be completed by someone other than the seller of the land.

f. Codes and Zoning

Incompatible or nonconforming zoning may necessitate a zoning change variance or a special exception land use permit. Zoning ordinance restrictions such as building height, setbacks, fence height, landscaping, screening requirements, placement and design of site signage, and size/number of parking spaces can affect site development costs and flexibility. These issues should be reviewed during the site selection process.

2. Site Design

With a good site available, site design and layout becomes the task. Good site design dictates that bus and car traffic should not cross or conflict. Likewise, students should not be required to cross car or bus traffic lanes either entering or leaving buses.

a. Vehicular Access

Access should be adequate, safe, convenient, and not confusing.

- A traffic study may be required to predict the impact of the school at peak times of arrival and dismissal.
- Consult the District Transportation Department, local street, or highway departments for turn lane, drive widths, and radius requirements.
- Review site distances at proposed entries/exits for hazardous conditions.
- Two or three entry/exit points into the site are required to provide appropriate separation of car and bus traffic.

b. Bus Pick-up and Drop-off (Bus Loop)

The bus loop should be arranged to provide separation from other vehicular traffic, particularly from the parent drop-off/pick-up drive(s). Bus loops should be designed to accommodate the maximum number of buses on site at one time plus one additional bus. Buses should not be required to back up. For planning purposes generally 15,000 square feet is used for bus loading areas.

- If diagonal bus parking is used, diagonal bus parking spaces should be 12 feet to 13 feet wide by the length of the bus. Spaces shall be aligned at a 45-degree to 60-degree angle to the curb. Angle diagonal bus parking spaces so the bus exit door will allow children to exit in front of the adjacent bus.
- Staff is usually on site prior to and after bus loading and unloading time; staff parking can be located within the bus loop or on one side of the bus loop in the area not required for bus traffic.

c. Parent Drop-off/Pick-up (Parent Loop)

The parent loop should be separate from the bus loop to avoid pedestrian and vehicular conflicts. Parent loops should be designed to accommodate the drop-off traffic without impacting the adjacent streets due to overflowing queues. It is usually desirable to have visitor parking near the parent drop-off. Parent loops should be 24 feet wide to provide the ability to pass parked cars along the drop-off curb.

d. Pedestrian Circulation

Pedestrian circulation must be safe, convenient, and without an excessive hardscape area to reduce pavement and storm water runoff.

- Provide walks a maximum of 12 feet wide from major drop-off drives to major entrances. Minor connecting walks are to be 5 feet wide.
- Walks are to be concrete, a minimum of 4 inches thick, with a light broom finish. Consider thickened or reinforced edges against paved areas.
- Walk slopes are to be a minimum of 1 percent to drainage and a maximum of 1:20. If walk exceeds 1:20, it will be designed as a ramp.

- Provide bollards or other features (rocks, boulders, planters, etc...) at the main entrance walk to block vehicles from gaining direct access to the main entrance.

e. Parking

Requirements vary with the type of school and with jurisdiction requirements. Special event parking is difficult to provide since these large events only occur one or two times per year. Parking requirements shall be as follows unless jurisdictional requirements require more parking. The district shall appeal to the local jurisdiction to meet these requirements.

i. Elementary School

For visitor and staff parking, provide parking at a rate of 1 space per 4.5 students (student design capacity). The minimum number of spaces for an elementary school is 10 spaces. Small schools will be evaluated on a case-by-case basis.

ii. Middle School

For visitor and staff parking, provide parking at a rate of 1 space per 4.5 students (student design capacity).

iii. High School

Provide 1 parking space per 2.5 students (student design capacity).

Provide parking spaces near delivery/receiving areas for food service and custodial staff.

Locate staff parking near the visitor parking for economy of pavement design where possible. Staff parking can also be located to one side of the bus drop-off area in the area not required for bus traffic.

Land required for parking should be 400 square feet per parking space which will include space for the parking space, drive isles, access roads, and islands.

Provide snow storage for the removal of snow from parking lots. Eliminate curbs and curbed islands were possible to reduce the concentration of storm water runoff, facilitate snow removal, and limit snow drifting.

f. Building Orientation

The orientation of the building is critical from an energy usage and comfort standpoint. The majority of windows should face in a north/south direction. Easy access to the main entrance should be obvious to all arriving at the school. Good site design requires careful and thorough planning to provide maximum safety and efficient utilization of site features. The following should be considered when orienting the building on the site:

- Optimal orientation of the building creates opportunities to utilize the potential contributions of the sun, topography, and existing vegetation for increased energy efficiency by maximizing heat gain (or minimizing heat loss) in the winter and minimizing heat gain in the summer. In the case of existing

buildings, arrangement of interior spaces, strategic landscaping, and modifications to the building envelope can mitigate unfavorable orientation.

- Consider east-west orientation to maximize north-south day lighting opportunities. Single-story designs offer "top lighting" daylight strategies for all spaces. By designing a building with a minimum width, increased daylight and ventilation opportunities are available.
- Plan site clearing and planting to take advantage of solar access. Solar orientation, cloud cover, and topography create unique site attributes. Orient the building to take advantage of solar energy for passive (and active) solar systems. The building should take advantage of shade and airflows to maximize summer cooling and to optimize passive solar energy for heating and wind protection during winter months.
- Orient building entrances and outdoor gathering spaces to maximize safety, ease of access, and protection from the elements.
- Building orientation can have a significant impact on the acoustical performance of a building. Locating noise producers away from noise sensitive areas is the primary goal. Barriers of solid walls or berms of earth, which break the line-of-site between the noise source and the receiver (e.g. classroom), can be effective in reducing sound intrusion. A single row of trees or shrubs will be ineffective in reducing unwanted sound.
- Drifting snow is a problem for most Wyoming schools. The building orientation should be planned so drifting snow does not impact building entrances, which can become a safety problem. Reviewing the snow drift performance of existing local buildings will provide the best information on building orientation and limit snow drift.

g. Soil Characteristics

Soil characteristics refer to the geotechnical engineering characteristics of the site soil and underlying geology. The site soil affects the foundation and pavement design as well as drainage and construction considerations.

- Obtain preliminary soil borings to obtain characteristics for foundation design, pavement design, storm sewer design, and excavation requirements.
- The presence of high ground water may result in the need for an underground drainage system.
- Erosion characteristics will affect the need for temporary and permanent measures for the Storm Water Pollution and Prevention Plan (SWPPP) measures. A disturbance over one acre that discharges into waters of the United States requires a SWPPP.
- If a geotechnical investigation was performed at an earlier time, those results need to be verified.

h. Grading, Drainage, and Storm Sewer System

- A storm water model will be completed to determine pre-developed and post-developed flow volume and peak runoff rates. Unless otherwise required by the local jurisdiction, a 25 year return period using a SCS Type II storm hydrograph should be used for the storm water model.
- Storm water must be detained on site and released at a rate that will not exceed current runoff rates and meet the requirements of the authority having jurisdiction.
- Create positive drainage away from the building. At the building perimeter, exterior grades shall be a minimum of 6 inches or more below the first floor level, except at the entrances. The ground around the building perimeter shall slope down and away from the building for a minimum of 20 feet to eliminate any standing water.
- Collect storm water in a series of inlets or swales to be detained and treated on site.
- Connect the building site storm drainage system by downspouts or roof drains to the building storm drainage system.
- All storm piping will be designed using the 25-year return period and intensity-duration curves consistent with the region.
- All storm piping and culverts shall have a smooth interior. All storm water pipe will be PVC, concrete, aluminized steel, or high-density polyethylene (HDPE).
- Design the project site to maintain the natural slope and water flows to promote infiltration.

i. Water and Sewer

- Sewage from school buildings will be discharged into an approved sewage system per applicable codes and per the requirements of the Wyoming Department of Environmental Quality.
- A water flow test will provide data on the available water flow in gallons per minute (gpm), static pressure available, and available residual pressure for fire protection systems.
- If a local water service is not available, an on-site well system is required. The on-site well system shall be required to provide water for domestic use and fire protection systems. When a well is considered, a test well is to be drilled if no other information is readily available for the site. The water system shall meet the requirements of the Wyoming Department of Environmental Quality.
- All water piping will be constructed in accordance with the local jurisdiction requirements and applicable construction standards.
- All sewer piping will be constructed in accordance with the local jurisdiction requirements and applicable construction standards and must be approved by the SFC.

j. Adjacent Property Facilities

- Screening of noise and views may be required. Minimize environmental pollution.
- Consider the safety of children walking to and from the school site during the use of outdoor athletic and play facilities.
- Adjacent railroad rights-of-way or busy streets may require the use of earth berms, landscaping, and/or fencing.

k. Easements and Right-of-Ways

- Easements and rights-of-way for roads, sewers, gas, power, water, and oil lines should be researched for potential development restrictions.
- Acquisition of additional rights-of-way may be required to accommodate left turn lanes, tapers, and utility extensions.

l. Environmental Restrictions

- Wetland delineation must be performed if the presence of a wetland is suspected. Jurisdictional wetlands, as defined by the U.S. Army Corps of Engineers, must be delineated and protected. Mitigation will be required if a jurisdictional wetland must be disturbed. Replacement ratios will be higher than the wetland being impacted. The most pristine wetlands are considered "unmitigable" – not allowed to be disturbed or replaced. Any fill or activity that impacts these wetlands must be permitted by the U.S. Army Corps of Engineers.
- Some state and local agencies may also require delineation, protection, and permitting of the wetlands.
- A designated wetland may prevent site development.
- Prevent polluting the air with dust and particle matter.

m. Testing

- A Phase I Environmental Assessment will be completed to evaluate the potential for environmental liabilities associated with current and past property use and to assess regulatory compliance. If a site fails the Phase I Environmental Assessment, the site is disqualified as a potential school site.
- Perform a site investigation and records search of hazardous materials used, stored, or disposed of on the property; proximity to landfills; adjoining property uses; proximity to properties listed on the U.S. Environmental Protection Agency, Comprehensive Environmental Response, Compensation, and Liability Information System.

n. Aesthetic Consideration

- It is preferable to choose a site with natural features compatible and complementary to the proposed building and site development.

o. Directional Signage

- Provide “Stop”, “Yield”, “No Parking”, "One-Way”, "Do Not Enter”, and/or other signs as necessary to maintain a fluid traffic stream.
- Signs, and the installation of signs, are to meet the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) or the authority having jurisdiction.
- For handicap signage consult ADA requirements.
- The address of the school is required on the building and must be readable from the street on which the building is fronted.

p. Elementary Playgrounds and Playfields

- Playgrounds will be sized based on 40 square feet per child, allowing for a hard surface play area and a soft surface play equipment area. The minimum size of playgrounds should be 2,400 square feet for playground apparatus and hard surface play area.
- Playfields will be based on 260 square feet per student. These may include half court basketball, tether ball, and general playfields. The minimum size for playfields should be 18,000 square feet.
- Playgrounds will be age appropriate.
- Play equipment must be in compliance with “ASTM F 1487-07ae1" or the most current version of the Standard Consumer Safety Performance Specification for Playground Equipment for Public Use and the current guidelines for public play equipment by the U.S. Consumer Product Safety Commission.
- The design of play equipment will comply with the ADA guidelines.
- Provide a firm, stable, slip-resistant, and resilient soft surface under and around play equipment. Depth and type of soft surfaces shall comply with "ASTM F 1292-04" or the most current version of Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.
- Provide an accessible route of travel through soft-surface play areas. Choice of surfacing and minimum areas of surfacing required shall comply with ADA guidelines.
- The SFC will established an allowance for playground equipment, relocation expenses, and soft surfacing for each elementary school.

q. Middle School Playfields

- Playfields will be sized based on 400 square feet per student.
- Provide an accessible route to all play areas and comply with ADA guidelines.

r. High School Playfields

- Playfields should be sized based on 550 square feet per student.

- Provide an accessible route to all play areas and comply with the ADA guidelines.
- Guidelines for athletic fields and tracks are located in Appendix C of this document.

s. Lighting

- Provide a 10-footcandle illumination level at the main building entrances. Provide a 5-footcandle illumination level at all entrances except the main entrance.
- Light fixtures will be a high-density discharge type located directly over doors, or a high-density discharge type recessed in overhangs or soffits located directly over doors. Fixtures will be designed for exterior use. Wall-mounted fixtures below 10 feet in height shall be vandal resistant.
- Provide an illumination level of 0.5 foot candles at the entrance/exit drives. Provide an illumination of 1.0 foot candles within parking areas and bus drop-off/pick-up areas.
- Lighting will be a high-intensity discharge type located on poles with a concrete base. Pole height will be a maximum of 30 feet. Lighting will be controlled by photoelectric cells, time clocks, or a time management system. The site design professional shall have discussions with the school district to determine light fixture switching and time clock programming.
- Minimize site lighting where possible and model the site lighting using a computer model.
- Shield all site lighting and minimize up-lighting. Avoid "Light Trespass"; use “Dark Sky” criteria.

t. Landscaping

- Landscaping will be used to enhance the building and provide adequate play areas for the students.
- Do not exceed 3:1 slope on lawn areas where mowing is required.
- On slopes greater than 3:1, provide slope controlled vegetation to retard erosion. Consider the safety of the children.
- Provide low maintenance shrubs and flowering trees to emphasize main building entries.
- Consider snow drifting and maintenance when designing landscape plantings.
- Consider native vegetation.
- Consider low-water-use landscaping including xeriscape. Xeriscaping refers to landscaping in ways that reduces or eliminates the need for supplemental irrigation.
- Limit or eliminate the use of potable water for landscape irrigation.

- Do not plant trees close (greater than 15 feet) to buildings. Trees, at maturity next to a building, allow students to access the roof, creating a safety and security issue.
- For landscaping, the SFC will establish an allowance for landscaping the site. Landscaping or development of excess land beyond the requirements of these guidelines or SFC rules is not eligible for SFC funding and will be considered an enhancement.
- Design building perimeter irrigation so that irrigation spray is prevented from getting onto the building.

Foundations

This section discusses recommended foundation types and their components. Other types of foundations may be acceptable. It is recommended that any foundation system other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements will be used when required by the current State or locally adopted building codes.

1. Types of Construction

The types of foundation systems include:

- Spread footings and wall footings
- Trenched footings/turned down footings
- Drilled piers
- Reinforced concrete masonry walls utilizing normal weight masonry units with all cores grouted and reinforced
- Concrete grade beams
- Driven piles and pile caps
- Auger cast piles and pile caps
- Geo-piers

2. Construction Standards

The following construction standards will be met on all foundation systems:

- Foundations will be designed by a licensed structural engineer to meet the recommendations given by a geotechnical engineer based upon their geotechnical investigation and report and in accordance with the current state building codes.
- Foundations must be structurally sound.
- Deflections and differential movement should be limited to magnitudes compatible with other building components.
- Foundations must be compatible with soil type.
- A water barrier will be used if recommended.
- Foundations will provide long life expectancy.
- Sub-slab ventilation will be provided in areas with radon or potential soil gas emissions. Requirements for such are to be determined by a qualified testing agency.
- Concrete's minimum compressive strength at 28 days will be as required by structural engineer's design but will be no less than the following:

- Foundations – 3,500 psi.
- Floor slabs – 3,500 psi.
- Precast systems – 5,000 psi.

- Concrete reinforcing steel will meet the requirements of the current State or locally adopted building code and the structural engineer's design.
- Project site concrete mixing will not be used, unless otherwise approved by an independent testing agency.
- For classrooms and corridor areas, use no less than a 4 inch thick concrete slab with 6 x 6 – W1.4 x W1.4 welded wire fabric.
- Under concrete building slabs, place a minimum 10 mil. vapor barrier and compact a minimum of 4 inches of drainage fill material unless the geotechnical engineer investigation recommends otherwise.
- Where expansive clays are present on the site, a geotechnical investigation will be conducted to address the issue and special foundation and floor slab systems and/or over excavating and backfilling shall be utilized as recommended by the geotechnical engineering investigation.

3. Design Guidelines

The following guidelines should be followed on all foundation systems:

- Use concrete materials with a maximum of 15 percent fly ash as a replacement but not an addition. The mix design will be completed by the concrete supplier and approved by the structural engineer or geotechnical engineer.
- Use low VOC and non-toxic form release agents.
- Evaluate all footing and foundation systems for the most cost effective for each respective requirement.
- Utilize the services of a Wyoming registered structural engineer.
- Utilize current geotechnical information for each site. Have the geotechnical engineer make recommendations for footing and foundation drainage in their response.

Structural Systems

This section discusses recommended structural systems and their components. Other types of foundations may be acceptable. It is recommended that any structural system other than noted in this section receive early review and approval from a SFC representative. Construction Standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements shall be used when required by the current State or locally adopted building codes.

1. Types of Construction

Types of structural systems include:

- Steel roof deck on open web steel joists or steel beams
- Cemetitious deck on open web joists
- Composite action concrete slabs and steel beams
- Pre-engineered building systems
- Concrete on steel form deck floor
- Cast-in-place floor slabs (1 way or 2 way)
- Steel and/or reinforced concrete columns and beams
- Load bearing masonry walls
- Wood frame systems
- Engineered wood products including engineered wood joists and beams, pre-engineered wood trusses, oriented strand board (OSB), and plywood

2. Construction Standards

The structural framing system shall be selected based on market area available trades and shall be cost effective and comply with the following:

- Structural systems will be structurally sound.
- Structural systems and members will be designed by a Wyoming licensed structural engineer to meet current state fire prevention and building codes and have adequate stiffness to limit deflections and lateral drift to the requirements of these codes.
- Provide steel roof decks as designed by the engineer.
- For cementitious decks, use galvanized sub-purlins.
- For roof slopes greater than 1:12, metal joists will span parallel to the slope.
- Do not use calcium chloride in the concrete.
- For structural steel, comply with the American Institute of Steel (AISC) specifications and current state building codes.
- Steel joist manufacturer will be certified by the Steel Joist Institute (SJI).

- Non-painted steel roof deck, if galvanized, will be "ASTM A924 G90" (90 oz. per sq. ft.) with zinc coating. Steel floor deck shall be galvanized and shall be "ASTM A924 G60".
- Concrete deck fill will have a minimum compressive strength of 3,500 psi or greater at 28 days.
- Structural steel fabrication must be in accordance with construction standards.
- Rolled steel columns and beams will be "ASTM A572", grade 50 (or others if recommended and approved by the engineer); square or rectangular hollow structural steel sections will be "ASTM Grade B", Fy=46 ksi; round hollow structural steel sections shall be "ASTM A500", Grade B, Fy=42 ksi.
- Concrete columns will have a minimum compressive strength of 3,500 psi or greater at 28 days.
- Steel form deck will comply with the Steel Deck Institute (SDI) design manual (publication no. 27).
- Structural masonry columns will be grout filled and reinforced.
- Load bearing masonry walls will comply with current state building codes.
- Steel lintels in exterior walls if 8 feet or less in depth and 12 feet or less in length will use hot-dipped galvanized, grade 65. For lintels greater in size, use "ASTM A123M-02".
- Steel lintels, other than angles, supporting masonry will have rigid masonry anchors at 32 inches maximum spacing to secure the masonry to the steel.
- Reinforced masonry lintels will be used in exterior walls wherever possible.
- Concrete mix design will be designed and strength tested by a qualified independent testing agency to meet these requirements and any others from the design professional.
- All lumber used for wood trusses shall be #2 grade, kiln dried, Southern Pine; #2 grade, kiln dried, Spruce-Pine-Fir; or #2 grade Hem-Fir or better. #3 grade lumber will not be allowed for chords or web members.

3. Design Guidelines

The following guidelines should be followed on all structural systems:

- Evaluate all framing systems for the most cost effective for each respective requirement.
- Utilize the services of a Wyoming registered structural engineer.
- Utilize current geotechnical information for each site. Have the geotechnical engineer make recommendations for footing and foundation drainage in their response.

Exterior Walls

This section discusses recommended exterior walls and their components. Other types of exterior walls may be acceptable. It is recommended that any exterior wall system other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements will be used when required by the current State or locally adopted building codes.

1. Types of Construction

Types of exterior walls include:

- Masonry cavity walls
- Veneer and metal framing walls
- Metal panel on metal framed walls
- Veneer and wood framed walls
- Fiber cement, steel, or aluminum siding on metal framed walls
- Fiber cement, steel, or aluminum siding on wood framed walls
- Cement stucco and metal framed walls
- Cement stucco and wood framed walls

2. Construction Standards

These construction standards apply to all exterior wall types:

- Exterior walls must be impact resistant and must resist damage from normal projectiles.
- Exterior walls must be moisture resistant. Provide a vapor barrier to the warm side of the insulation layer. Provide weep holes at the masonry veneer walls.
- Exterior walls must be thermal resistant with a minimum U-factor of 0.074. Evaluate the total wall assembly to attain a minimum U-factor of 0.05. Consider long term performance.
- Exterior walls must have minimum maintenance. Provide wall construction that does not require annual maintenance. Finishes that require paint or stain every 7 to 10 years are acceptable.

3. Design Guidelines

These guidelines apply to all exterior wall types:

- Exterior walls must be economical. Consider life cycle evaluations when selecting exterior wall construction.
    - Value engineer your choices before your final selection; consider function and life cycle cost.

- Light-colored exterior walls are recommended.

a. Masonry Cavity Walls

The designer is encouraged to utilize oversized or jumbo brick masonry or CMU products. Reduce complexities by having only two or three variations in product regarding color and texture. Where durability is critical on the interior surfaces, look at utilizing insulated CMU products to increase the overall wall "U" value. Stone or faux stone is accepted on a limited basis.

i. Components

- Use exterior stone, clay, or concrete masonry units (CMU).
- A minimum 2 inch clear cavity is recommended.
- For rigid insulation, seal the inside face and seams with tape or mastic. Sprayed on urethane foam insulation will be considered and approved based on a life cycle cost analysis.
- Use interior clay or concrete masonry units.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required select products for their fire resistance properties.
- For in-wall flashings use copper fabric laminate, elastomeric thermoplastic, or sheet metal.
- Drain the cavity with weep holes at a maximum of 4 feet on center.
- Wall reinforcement will meet the requirements of the current state building codes, including seismic provisions where applicable.
- Face brick will be grade SW.
- Clay masonry compressive strength as per "ASTM C67".
- Concrete masonry compressive strength as per "ASTM C140".
- Mortar compressive strength as per "ASTM C780".
- Grout compressive strength as per "ASTM C1019".
- Mortar water retention as per "ASTM C1506".
- Mortar air content as per "ASTM C91".

b. Veneer and Metal Framed Walls

The designer is encouraged to utilize oversized or jumbo brick masonry or CMU products. Reduce complexities by having only two or three variations in products regarding color and texture. Take care to avoid moisture in the wall cavity. Stone or faux stone is accepted on a limited basis.

i. Components

- Use exterior stone, clay, or concrete masonry units (CMU).
- A minimum 2 inch clear cavity is recommended.
- For rigid insulation seal the inside face and seams with tape or mastic. It is encouraged to use a minimum of 1 inch rigid insulation in the wall cavity in addition to the wall insulation in the wall framing.
- Provide a metal stud framing system.
- Provide a vapor barrier on the warm side of wall insulation. Interior finishes are addressed in the Interior Floor Finishes section of these guidelines.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required, select products for their fire resistance properties.
- For in-wall flashings, use copper fabric laminate, elastomeric thermoplastic, or sheet metal.
- Drain the cavity with weep holes at a maximum of 4 feet on center.
- Wall reinforcement will meet the requirements of the current state building codes, including seismic provisions where applicable.
- Face brick will be grade SW.
- Clay masonry compressive strength as per "ASTM C67".
- Concrete masonry compressive strength as per "ASTM C140".
- Mortar compressive strength as per "ASTM C780".
- Grout compressive strength as per "ASTM C1019".
- Mortar water retention as per "ASTM C1506".
- Mortar air content as per "ASTM C91".
- For metal framing structural performance, provide cold-formed metal framing capable of withstanding design loads as per a Wyoming registered structural engineer's recommendations. Comply with the American Iron and Steel Institute's (AISI) "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions". Provide a minimum 20 gauge steel framing members.

c. Metal Panel on Metal Framed Walls

Avoid, if possible, all metal/insulated panel systems. Provide required wall thermal characteristics by the total wall assembly. Take care to avoid moisture in the wall cavity.

i. Components

- Provide architectural metal panels.
- A minimum of 2 inches clear cavity is recommended.
- Provide plywood, OSB, or gypsum board sheathing as directed by the project's structural engineer and/or architect.
- For rigid insulation seal, the inside face and seams with tape or mastic. A minimum of 1 inch rigid insulation in the wall cavity in addition to the wall insulation in the wall framing is encouraged.
- Provide a metal stud framing system.
- Provide a vapor barrier on the warm side of wall insulation. The interior finishes are addressed in the Interior Floor Finishes section of these guidelines.
- Metal insulated panels are discouraged unless the design team can show that the total wall system costs are competitive with non-insulated metal systems.
- The designer is encouraged to minimize the number of colors or styles of metal panel systems.

ii. Construction Standards

- Metal panel structural performance shall be capable of withstanding the effects of gravity loads and stresses based on testing according to "ASTM E 330".
- Provide products for their impact, moisture, and thermal resistance.
- Where required, select products for their fire resistance properties.
- Provide for positive cavity drainage at the bottom of the wall system.
- Aluminum siding shall comply with "AAMA 1402".
- For metal framing structural performance, provide cold-formed metal framing capable of withstanding design loads per a Wyoming registered engineer's recommendations. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions".
- Provide a minimum 20 gauge steel framing members.

d. Veneer and Wood Framed Walls

This component only occurs in Type V building types and will, therefore, have limited use in Wyoming. The designer is encouraged to utilize oversized or jumbo brick masonry or CMU products. Reduce complexities by having only two or three variations in products regarding color and texture. Stone or faux stone is accepted on a limited basis.

i. Components

- Provide exterior stone, clay, or concrete masonry units (CMU). Where durability is critical on the interior surfaces, look at utilizing insulated CMU products to increase the overall wall "U" value.
- A minimum of 2 inches clear cavity is recommended.
- For rigid insulation seal the inside face and seams with tape or mastic. It is encouraged to use a minimum of 1 inch rigid insulation in the wall cavity in addition to the wall insulation in the wall framing.
- Provide plywood, OSB, or gypsum board sheathing as directed by the project's structural engineer and/or architect.
- Provide a minimum of 2 inch by 6 inch wood framing system.
- Provide a vapor barrier on the warm side of the wall insulation. Interior finishes are addressed in the Interior Floor Finishes section of these guidelines.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required, select products for their fire resistance properties.
- For in-wall flashings, use copper fabric laminate, elastomeric thermoplastic, or sheet metal.
- Drain the cavity with weep holes at a maximum of 4 feet on center.
- Wall reinforcement will meet the requirements of the current state building codes, including seismic provisions where applicable.
- Face brick will be grade SW.
- Clay masonry compressive strength as per "ASTM C67".
- Concrete masonry compressive strength as per "ASTM C140".
- Mortar compressive strength as per "ASTM C780".
- Grout compressive strength as per "ASTM C1019".
- Mortar water retention as per "ASTM C1506".
- Mortar air content as per "ASTM C91".
- Maximum moisture content of wall framing members will be 19 percent. Provide wood grading as specified by the structural engineer.

e. Fiber Cement, Steel, or Aluminum Siding on Metal Framed Walls

The designer is encouraged to minimize the types of different sidings used. Wood sidings are discouraged due to annual maintenance costs.

i. Components

- Fiber cement board is acceptable for exterior walls, soffits, and fascias. Provide high quality paint or stain for a long lasting finish. Minimize the type and color of products used.
- Aluminum or steel siding should be selected for its low maintenance features. Colors and textures shall be minimized.
- Provide for moisture to escape at the bottom of this wall system.
- For rigid insulation, seal the inside face and seams with tape or mastic. It is encouraged to use a minimum of 1 inch rigid insulation in the wall cavity in addition to the wall insulation in the wall framing.
- Provide plywood, OSB, or gypsum board sheathing as directed by the project's structural engineer and/or architect.
- Provide a metal stud framing system.
- Provide a vapor barrier on the warm side of wall insulation. Interior finishes are addressed in the Interior Floor Finishes section of these guidelines.
- Due to the staining process, weathering steel siding is discouraged.
- For thermal reasons, lighter colored selections are encouraged.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required select products for their fire resistance properties.
- Fiber cement siding shall conform to "ASTM C1186", Type A, Grade II fiber cement board.
- Aluminum siding shall comply with "AAMA 1402".
- For metal framing structural performance, provide cold-formed metal framing capable of withstanding design loads per a Wyoming registered structural engineer's recommendations. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions".
- Provide a minimum of 20 gauge steel framing members.

f. Fiber Cement, Steel, or Aluminum Siding on Wood Framed Walls

The designer is encouraged to minimize the types of different sidings used. Wood sidings are discouraged due to annual maintenance costs.

i. Components

- Fiber cement board is acceptable for exterior walls, soffits, and fascias. Provide high quality paint or stain for a long lasting finish. Minimize the type and color of products used.

- Aluminum or steel siding should be selected for its low maintenance features. Colors and textures shall be minimized.
- Provide for moisture to escape at the bottom of this wall system.
- For rigid insulation seal the inside face and seams with tape or mastic. It is encouraged to use a minimum of 1 inch rigid insulation in the wall cavity in addition to the wall insulation in the wall framing.
- Provide plywood, OSB, or gypsum board sheathing as directed by the project's structural engineer and/or architect.
- Provide a minimum of 2 inch by 6 inch wood framing members.
- Provide a vapor barrier on the warm side of wall insulation. Interior finishes are addressed in the Interior Floor Finishes section of these guidelines.
- Due to the staining process, weathering steel siding is discouraged.
- For thermal reasons, lighter colored selections are encouraged.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required, select products for their fire resistance properties.
- Fiber Cement siding shall conform to "ASTM C1186", Type A, Grade II fiber cement board.
- Aluminum siding shall comply with "AAMA 1402".
- Maximum moisture content of wall framing members shall be 19 percent. Provide wood grading as specified by the project's structural engineer.

g. Cement Stucco and Metal Framed Walls

i. Components

- Provide Portland Cement Plaster and expanded metal lath as per manufactures recommendations for proposed application.
- Provide 15 pound asphalt felt over exterior sheathing.
- Provide for moisture to escape at the bottom of this wall system.
- Provide plywood, OSB, or gypsum board sheathing as directed by the project's structural engineer and/or architect.
- Provide a metal stud framing system.
- Provide a vapor barrier on the warm side of wall insulation. Interior finishes are addressed in the Interior Floor Finishes section of these guidelines.
- For thermal reasons, lighter colored selections are encouraged.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required, select products for their fire resistance properties.
- Provide Portland cement per "ASTM C 150".
- Install expanded-metal lath according to "ASTM C 1063".
- For metal framing structural performance, provide cold-formed metal framing capable of withstanding design loads per a Wyoming registered engineer's recommendations. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
- Provide a minimum 20 gauge steel framing members.
- Provide asphalt-saturated organic felt per "ASTM D 226", Type I (15 pound asphalt felt), un-perforated.
- Apply and cure the plaster to prevent the plaster from drying out during the curing period.
- Use procedures required by climatic conditions including moisture curing, providing coverings, and providing barriers to deflect sunlight and wind.
- Apply plaster when ambient temperature is greater than 40 degrees Fahrenheit.
- Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

h. Cement Stucco and Wood Framed Walls

i. Components

- Provide Portland cement plaster and expanded metal lath as per manufactures recommendations for proposed application.
- Provide 15 pound asphalt felt over exterior sheathing.
- Provide for moisture to escape at the bottom of this wall system.
- Provide plywood, OSB, or gypsum board sheathing as directed by the project's structural engineer and/or architect.
- Provide a metal stud framing system.
- Provide a vapor barrier on the warm side of wall insulation. Interior finishes are addressed in the Interior Floor Finishes section of these guidelines.
- For thermal reasons, lighter colored selections are encouraged.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.

- Where required, select products for their fire resistance properties.
- Provide Portland cement per "ASTM C 150".
- Install expanded-metal lath according to "ASTM C 1063".
- Provide asphalt-saturated organic felt per "ASTM D 226", Type I (15 pound asphalt felt), un-perforated.
- Maximum moisture content of wall framing members shall be 19 percent. Provide wood grading as specified by the project's structural engineer.
- Apply and cure the plaster to prevent the plaster from drying out during the curing period.
- Use procedures required by climatic conditions including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
- Apply plaster when ambient temperature is greater than 40 degrees Fahrenheit.
- Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- Locate control joints per industry standards.

Roof Assemblies

This section discusses recommended roofs and their components. Other types of roof systems may be acceptable. It is recommended that any roof assembly other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements will be used when required by the current State or locally adopted building codes.

1. Types of Construction

Types of roofs include:

- Shingle roof system
- Metal roof with batt insulation
- Built-up roof system
- Single-ply roof system
- Metal roof with rigid insulation

2. Construction Standards

These construction standards apply to all roof types:

a. Moisture Resistant

Roofing type should be selected by its ability to provide a water tight assembly within the design constraints of the type of structure required.

b. Thermal Resistant

Minimum R-values for low slope roofs shall be 30 and steep roofs 38.

c. Positive Slope

A minimum slope of ½ inch per 12 inches, unless specified otherwise.

d. Minimal Maintenance

Upkeep of a roof is acceptable but continual maintenance to a roof type is not acceptable.

e. Wind/Weather Resistant

All roof types must meet Factory Mutual (FM) uplift criteria for proposed locations throughout the State of Wyoming.

f. Positive Drainage to Interior Drains or Exterior Sources

Provide positive drainage to interior roof drains where practical. Provide overflow pipe drains or scuppers at all interior roof drains. Pipe overflows so that the building maintenance personnel can readily identify when a roof drain is plugged.

g. Fire Resistive

All roof types must meet Underwriters Laboratories (UL) class A rating or what maybe allowed by the desired building type with local building codes.

h. "ENERGY STAR" Compliance

Provide "ENERGY STAR" compliant ratings for surface treatments.

i. "Radiant Barriers"

Consider "radiant barriers" such as aluminum foil at the ceiling of attics.

3. Types of Roof Systems

a. Shingle Roof System

i. Components

- Provide asphalt shingles, UL class "A", or concrete tile shingles.
- Provide felt or membrane underlayment. Use a 30 pound felt or ice and water shield material. Provide, at a minimum, ice and water shields at all eaves and valleys.
- For nailing board, use oriented strand board (OSB) or plywood. Provide the thickness as directed by the project's structural engineer. Nailing board is not necessary if rigid insulation is not used.
- If rigid deck insulation is provided, provide a vapor barrier on the underside of either extruded polystyrene or polyisocyanurate boards.
- Provide a vapor barrier of 30 pound felt as a minimum.
- For the structural roof deck, provide either OSB or plywood as directed by the project's structural engineer.
- Other types of roofing shingles may be acceptable. It is recommended that any roofing type other than noted above receive early review and approval from a SFC representative. More stringent requirements shall be used when required by the current state building codes.

ii. Construction Standards

- Glass fiber-reinforced asphalt shingles will meet "ASTM D3462" construction standards.
- Organic felt-reinforced asphalt shingles will meet "ASTM D225" construction standards.
- Concrete tile shingles will meet "ASTM C 1492" construction standards.
- Provide exterior fire test exposure, class "A" as per "ASTM E108" or "UL 790" construction standards.
- Fabricated sheet metal flashings and trim will comply with the recommendations in Sheet Metal and Air Conditioning Contractors

National Association's (SMACNA) “Architectural Sheet Metal Manual” that apply to design, dimensions, metal, and other characteristics.

- Provide a minimum 3:12 roof slope or pitch.
- Provide a minimum 40 year material warranty.
- Provide for design wind speeds of 100 mph.
- Fasten shingles to roof sheathing with nails not staple fasteners.
- Metal drip edge will be brake formed sheet metal with at least a 2 inch roof deck flange. Material shall be a factory baked finish.
- Felt underlayment will be a minimum of 30 pound asphalt-saturated organic felts, non-perforated. Use ice and water shield material where slopes are less than 4:12 and at all eaves and valleys.

iii. Guidelines

- The designer is encouraged to minimize the number of colors or styles of metal roofing systems.
- Roofs must be economical. Consider life cycle evaluations when selecting a roof type.
- Value engineer your choice before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.
- Hold a pre-installation roofing conference at the project site to address the following:
    - Meet with the owner, architect, owner's insurer if applicable, sheet metal roofing installer, portable roll-forming equipment manufacturer's representative for sheet metal roofing, metal deck or sheathing installer, and installers whose work interfaces with or affects sheet metal roofing, including installers of roof accessories and roof-mounted equipment.
    - Review and finalize the construction schedule and verify the availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - Review the methods and procedures related to sheet metal roofing installation, including portable roll-forming equipment per manufacturer's written instructions.
    - Examine the metal deck or sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
    - Review the structural loading limitations of the metal deck or sheathing during and after roofing installation.

- Review the flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal roofing.
- Review the governing regulations and requirements for insurance, certificates, testing, and inspecting if applicable.
- Review the temporary protection requirements for sheet metal roofing during and after roofing installation.
- Review the roof observation and repair procedures after the sheet metal roofing installation.
- Document proceedings, including corrective measures and actions required, and furnish a copy of the record to each participant.

b. Metal Roof with Batt Insulation

i. Components

- Metal panels flat-seam, standing-seam, or batten-seam roofing systems are acceptable.
- Provide insulation that is a glass fiber blanket with vapor tight edge tabs and facer on the underside. To be sure of the vapor barrier, friction fit blankets can be used with a 10 mil. poly vapor barrier continuous on the warm side of the insulation.
- Provide galvanized steel purlins or wood decking (lumber, plywood, or OSB).
- Provide steel or wooden joist/trusses or other structural members.
- Other types of metal roofing assemblies may be acceptable. It is recommended that any roofing type other than noted above receive early review and approval from a SFC representative. More stringent requirements shall be used when required by the current State Building Codes.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required select products for their fire resistance properties.
- Provide a roofing system that is listed on the Department of Energy's (DOE) ENERGY STAR "Roof Products Qualified Product List" for pitched roof products.
- Provide metal roofing with a solar reflectance index not less than 78 when calculated according to "ASTM E 1980" based on testing identical products by a qualified testing agency.
- Provide a 20 year finish and weather tightness warrantee.

- For metallic-coated steel sheet, provide restricted flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with "ASTM A 755/A 755M".
- Zinc-coated (galvanized) steel sheet will comply with "ASTM A 653/A 653M", G90 coating designation; structural quality.
- Provide a minimum 3:12 roof slope unless the manufacturer's system will warranty a lesser slope (metal building manufacturers).
- SMACNA recommends 30 pound felt or self-adhering sheet underlayment. Rosin-sized building paper should be used as a slip sheet over other types of underlayment materials.
- For sheet metal roofing standards comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on the drawings.
- For metal protection where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying a self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by the fabricator of sheet metal roofing or manufacturers of the metals in contact.
- Install felt underlayment on the roof sheathing under the sheet metal roofing. Use adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal roofing. Apply at locations indicated, in shingle fashion to shed water with lapped joints of not less than 2 inches.
- Conceal fasteners and expansion provisions where possible in the exposed work and locate to minimize the possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation. Compensate for thermal expansion/contraction for fastening system.
- For stop-type snow guards, attach snow guards to sheet metal roofing with adhesive or adhesive tape, as recommended by the manufacturer. Do not use fasteners that will penetrate the sheet metal roofing.
- For bar-type snow guards, attach bar supports to vertical ribs of the standing-seam sheet metal roofing with clamps or set screws. Do not use fasteners that will penetrate the sheet metal roofing.

iii. Guidelines

- The designer is encouraged to minimize the number of colors or styles of metal roofing systems.
- Roofs must be economical. Consider life cycle evaluations when selecting a roof type.

- Value engineer your choice before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.
- Hold a pre-installation roofing conference at the project site to address the following:
    - Meet with the owner, architect, owner's insurer if applicable, sheet metal roofing installer, portable roll-forming equipment manufacturer's representative for sheet metal roofing, metal deck or sheathing installer, and installers whose work interfaces with or affects sheet metal roofing, including installers of roof accessories and roof-mounted equipment.
    - Review and finalize the construction schedule and verify the availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - Review the methods and procedures related to sheet metal roofing installation, including portable roll-forming equipment per manufacturer's written instructions.
    - Examine the metal deck or sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
    - Review the structural loading limitations of the metal deck or sheathing during and after roofing installation.
    - Review the flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal roofing.
    - Review the governing regulations and requirements for insurance, certificates, testing, and inspecting if applicable.
    - Review the temporary protection requirements for sheet metal roofing during and after roofing installation.
    - Review the roof observation and repair procedures after the sheet metal roofing installation.
    - Document proceedings, including corrective measures and actions required, and furnish a copy of the record to each participant.

c. Built-up Roof System

i. Components

- Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by the built-up roofing manufacturer based on testing and field experience.

- A minimum 4-ply built-up roof system is required. Provide a light colored (grey or white) mineral cap sheet with other plies over the base sheet and a vapor retarder.
- Depending on the roof assembly utilized, the designer may use rigid board insulation on the deck and/or provide additional insulation below the decking material. Depending on the placement of the insulation layer, if an attic is created, this area will need to be ventilated to meet or exceed all local governing building codes. When selecting insulation levels, refer to the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 90.1. R-values required by local building codes should be considered a minimum.
- Provide a metal, concrete, or wood (lumber, plywood, or OSB) roof deck to meet structural requirements as directed by the project's structural engineer.
- A vapor barrier will be required on the warm side of the insulation layer to stop migrating vapor from the inside of the building into the wall or roof assembly.
- Other types of built-up roofing systems may be acceptable. It is recommended that any roofing type other than noted above receive early review and approval from a SFC representative. More stringent requirements shall be used when required by the current State Building Codes.

ii. Construction Standards

- Provide built-up roofing, base flashings, and component materials that comply with the requirements in FM Approvals 4450 and FM Approvals 4470 as part of a built-up roofing system and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
- A minimum 4-ply built-up roof system is required.
- Provide products that meet or exceed local codes for fire/windstorm classification for appropriate areas of the State of Wyoming.
- Provide a roofing system with initial Solar Reflectance Index not less than 78 when calculated according to "ASTM E 1980" based on testing identical products by a qualified testing agency.
- Provide a roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per "ASTM E 119" by a qualified testing agency. Identify products with the appropriate markings of the applicable testing agency.

- Provide a built-up roofing system that is identical to the systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to "ASCE/SEI 7".
- Provide a minimum roof slope of ¼ inch per12 inches. The slope should be first attempted by sloping the structure where possible.
- Sheathing paper may be required as a slip sheet over wood-plank roof decks, usually under the base sheet.
- For the base sheet comply with "ASTM D 4601", Type II, SBS-modified, asphalt-impregnated and asphalt-coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides.
- For the ply sheet comply with "ASTM D 2178", Type IV, asphalt-impregnated, glass-fiber felt.
- For the cap sheet comply with "ASTM D 3909", asphalt-impregnated and asphalt-coated, glass-fiber cap sheet, with white coarse mineral-granule top surfacing and fine mineral surfacing on the bottom surface.
- Provide modified bituminous flashing at cant strips, roof edges, and all penetrations through the roof.

iii. Guidelines

- Roofing applications should be looked at as a total roofing system to include roofing, insulation, vapor barriers, roof decking, roof structure, and the ceilings below.
- Roofs must be economical. Consider life cycle evaluations when selecting a roof type.
- Value engineer your choice before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.
- Hold a pre-roofing conference prior to field installation and address the following:
    - Meet with the owner, architect, owner's insurer if applicable, testing and inspecting agency representative, roofing installer, roofing manufacturer's representative, deck installer, and installers whose work interfaces with or affects the roofing, including installers of roof accessories and roof-mounted equipment.
    - Review the methods and procedures related to the roofing installation, including the manufacturer's written instructions.
    - Review and finalize the construction schedule and verify the availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.

- Review the deck substrate requirements for conditions and finishes, including flatness and fastening.
- Review the structural loading limitations of the roof deck during and after roofing.
- Review the base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
- Review the governing regulations and requirements for insurance and certificates if applicable.
- Review the temporary protection requirements for roofing during and after installation.
- Review the roof observation and repair procedures after roofing installation.

d. Single-ply Roof System

i. Components

- Substrate boards may serve as building-code-required thermal barriers, separating foam insulation from a steel or wood deck. They may also be used over a steel deck as part of a fire-resistance-rated roofing system or to provide a smooth substrate for a vapor retarder. Verify suitability for application.
- Review the compatibility of a vapor retarder with other membrane roofing system materials.
- Preformed roof insulation boards manufactured or approved by thermoplastic polyolefin roofing (TPO) or ethylene propylene diene monomers (EPDM) membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, and that produce FM Approvals-approved roof insulation only.
- Cover or overlay boards are usually needed over non-composite foam insulation.
- Provide a metal, concrete, or wood (lumber, plywood, or OSB) roof deck to meet the structural requirements as directed by the project's structural engineer.
- Provide steel or wooden joist/trusses or other structural members.
- Other types of single-ply roofing systems may be acceptable. It is recommended that any roofing type other than noted above receive early review and approval from a SFC representative. More stringent requirements shall be used when required by the current State Building Codes.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required select products for their fire resistance properties.
- Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by the membrane roofing manufacturer based on testing and field experience.
- Provide a membrane roofing system that is identical to the systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to "ASCE/SEI 7".
- Provide a roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products. EPDM roofs require a coating for an "ENERGY STAR" listing.
- Provide a 20 year finish and weather tightness warrantee.
- The roofing contractor shall provide a 2 year guarantee warranting workmanship of all roofing systems, insulation, and flashing work.
- Provide a class “A, B, or C” UL roof system per Table 1505.1 of the IBC. Exterior fire-test exposure per "ASTM E 108" or "UL790" for application and roof slopes indicated.
- Provide a minimum roof slope of ¼ inch per12 inches.
- Fully adhered or mechanically fastened TPO or EPDM membrane, 60 mil minimum thickness. Ballasted roofing systems are not approved without prior approval of a SFC representative.
- A qualified firm that is approved, authorized, or licensed by a membrane roofing system manufacturer shall install the manufacturer's product, which is eligible to receive the manufacturer's special warranty.
- Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per "ASTM E 119" by a qualified testing agency. Identify products with appropriate markings of an applicable testing agency.

iii. Guidelines

- The designer is encouraged to use roof colors with solar reflectance not less than 0.70 and emissivity not less than .075 when tested according to "CRRC-1" (Cool Roof Rating Council).

- Roofs must be economical. Consider life cycle evaluations when selecting a roof type.
- Value engineer your choice before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.
- Hold a pre-installation roofing conference at the project site to address the following:
    - Meet with the owner, architect, owner's insurer if applicable, testing and inspecting agency representative, roofing installer, roofing system manufacturer's representative, deck installer, and installers whose work interfaces with or affects the roofing, including installers of roof accessories and roof-mounted equipment.
    - Review the methods and procedures related to roofing installation, including manufacturer's written instructions.
    - Review and finalize the construction schedule and verify the availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
    - Review the structural loading limitations of roof deck during and after roofing.
    - Review the base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
    - Review the governing regulations and requirements for insurance and certificates if applicable.
    - Review the temporary protection requirements for the roofing system during and after installation.
    - Review the roof observation and repair procedures after roofing installation.

e. Metal Roof with Rigid Insulation

i. Components

- For metal panels, flat-seam, standing-seam, or batten-seam roofing systems are acceptable.
- Provide rigid roof insulation of one or two layers.
- Provide underlayment of building felt or ice and water shield.

- Provide galvanized steel purlins or wood decking (lumber, plywood, or OSB).
- Provide steel or wooden joist/trusses or other structural members.
- Other types of metal roofing systems may be acceptable. It is recommended that any roofing type other than noted above receive early review and approval from a SFC representative. More stringent requirements shall be used when required by the current State Building Codes.

ii. Construction Standards

- Provide products for their impact, moisture, and thermal resistance.
- Where required, select products for their fire resistance properties.
- Provide a roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for pitched roof products.
- Provide metal roofing with a solar reflectance index of not less than 78 when calculated according to "ASTM E 1980" based on testing identical products by a qualified testing agency.
- Provide a 20 year finish and weather tightness warrantee.
- Restricted flatness steel sheet, metallic coated by the hot-dip process, and pre-painted by the coil-coating process shall comply with "ASTM A 755/A 755M". Zinc-coated (galvanized) steel sheet shall comply with "ASTM A 653/A 653M", G90 coating designation; structural quality.
- The system shall have an "ASTM E 1592-94" wind uplift classification.
- Do not allow water penetration when tested according to "ASTM E 1646".
- Provide a minimum 3:12 roof slope unless the manufacturer's system will warranty a lesser slope (metal building manufacturers).
- SMACNA recommends 30 pound felt or self-adhering sheet underlayment. Rosin-sized building paper should be used as a slip sheet over other types of underlayment materials.
- For sheet metal roofing standards comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on the drawings.
- Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by the fabricator of the sheet metal roofing or the manufacturer of the metals in contact.
- Install felt underlayment on roof sheathing under the sheet metal roofing. Use adhesive for temporary anchorage to minimize the use of mechanical fasteners under the sheet metal roofing. Apply at locations

indicated, in shingle fashion to shed water with lapped joints of not less than 2 inches.

- Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize the possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- For stop-type snow guards, attach snow guards to the sheet metal roofing with adhesive or adhesive tape, as recommended by the manufacturer. Do not use fasteners that will penetrate the sheet metal roofing.
- For bar-type snow guards, attach bar supports to the vertical ribs of standing-seam sheet metal roofing with clamps or set screws. Do not use fasteners that will penetrate the sheet metal roofing.

iii. Guidelines

- The designer is encouraged to minimize the number of colors or styles of metal roofing systems.
- Roofs must be economical. Consider life cycle evaluations when selecting a roof type.
- Value engineer your choice before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.
- Hold a pre-installation roofing conference at the project site to address the following:
    - Meet with the owner, architect, owner's insurer if applicable, sheet metal roofing installer, portable roll-forming equipment manufacturer's representative for the sheet metal roofing, metal deck or sheathing installer, and installers whose work interfaces with or affects the sheet metal roofing including installers of roof accessories and roof-mounted equipment.
    - Review and finalize the construction schedule and verify the availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - Review the methods and procedures related to sheet metal roofing installation, including the portable roll-forming equipment manufacturer's written instructions.
    - Examine the metal deck or sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
    - Review the structural loading limitations of the metal deck or the sheathing during and after the roofing installation.

- Review the flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect the sheet metal roofing.
- Review the governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
- Review the temporary protection requirements for sheet metal roofing during and after roofing installation.
- Review the roof observation and repair procedures after the sheet metal roofing installation.
- Document the proceedings, including corrective measures and actions required and furnish a copy of record to each participant.

Interior Partitions

This section discusses recommended interior partitions and their components. Other types of interior partitions may be acceptable. It is recommended that any interior partitions other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements will be used when required by the current State or locally adopted building codes.

1. Types of Construction

Types of interior partitions include:

- Concrete masonry walls (CMU)
- Structural glazed tile walls (CGFU)
- Ceramic tile on framed walls (CT)
- Gypsum wallboard and high impact gypsum wall board on framed walls
- Veneer plaster over gypsum wall board on framed walls
- Operable partitions
- Folding partitions
- Demountable partitions

2. Guidelines

- Use easy to clean materials.
- Use materials resistant to moisture or that inhibits the growth of biological contaminants.
- Use impact resistant materials in high traffic areas.
- Use durable, long life materials.
- Use sustainable materials.
- Use dimensional planning to reduce waste (i.e. 4 foot by 8 foot wall board).
- Use materials that meet industry consensus standards for Volital Offgassing Components (VOC) emissions.
- Consider designing for the disassembly for a product and its parts to be reused, remanufactured, or recycled.
- Use products with good acoustical qualities.
- Consider recycled/recyclable products.
- Use products and materials that are produced locally (within 500 miles) when possible.
- Consider renewable materials.

- Value engineer your choices before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.

a. CMU/CGFU/CT

i. Guidelines

- Impact resistant
- Easily cleanable and maintainable
- Good acoustic qualities
- Daylight enhancement qualities

ii. Construction Standards

- For CMU walls comply with "ASTM C190", 1900 psi compressive strength, normal weight aggregate.
- Provide tooled or struck mortar joints for cleaning ability. Use Type “S” mortar for load bearing walls and Type “N” for non-load bearing walls.
- For glazed structural clay tile, comply with "ASTM C126", Type I (single-faced units) and Type II (double faced units).
- Ceramic tile: For materials "ANSI A137.1" comply with "Specifications for Ceramic Tile”; for installation ANSI 108 series and TCA handbook.
- For glazed wall tile provide 5/16 inch thick, flat tile with cushion edges.
- Grout tile using latex Portland cement grout. Use chemical resistant epoxy grout in kitchens and science laboratories.

b. Gypsum Wall Board/Veneer Plaster over Gypsum Wall Board on either Wood or Metal Framed Partitions

i. Guidelines

- “Abrasive-resistant” and “high impact” in high traffic areas
- Economical
- Accommodates periodic color changes
- Good sound barrier with acoustical insulation

ii. Construction Standards

- Do not use in exterior walls where the threat of moisture and mold might be present.
- Provide a minimum sound transmission characteristic (STC) of 41 in academic areas.
- Comply with "ASTM C754" and G40 hot dipped galvanized zinc coating for steel framing.

- For gypsum wallboard, comply with "ASTM C36", Type X, 5/8 inch thick.
- For metal studs, comply with "ASTM C645", 20 gauge minimum sheet base metal.
- Provide control joints in partitions at 30 feet maximum.
- For veneer plaster comply with "ASTM C58T" consisting of a separate base and finish coat.
- Provide wood stud grade marked as required by the applicable building code.

c. Operable/Folding/Demountable Partitions

i. Guidelines

- Easily moved from opened to closed (stored) position by manual or electrical operating mechanism.
- Provide an STC rating as required meeting the sound isolation requirements for the functional use of the rooms or spaces to be divided.
- Provide options for tack and marker board surfaces.
- Provide overhead structural support with minimal deflection as required for functional operation.
- Provide demountable partitions that are convenient to disassemble and relocate.

ii. Construction Standards

- Provide manually or electrically operated partitions.
- Operable partitions shall be panels ½ inch gypsum board laminated with 3/16 inch natural cork (STC 47) or steel faced sheet (STC 50); panel finish vinyl fabric, carpet, tack boards, or marker boards; pedestrian pass doors as required.
- For accordion folding partitions, provide steel or aluminum suspension tracks; manually operated; interior 22 gauge steel panels for sound isolation; vinyl coated fabric finish.
- For demountable partitions provide face panels of gypsum board painted or covered with vinyl; face panels of steel painted or covered with vinyl or plastic laminate; doors and windows available as required.
- Provide non-combustible products that meet rated fire or smoke separation building code requirements.
- Doors and windows in operable partitions shall be avoided.

Doors/Windows

This section discusses recommended door and window types and their components. Other types of doors and windows may be acceptable. It is recommended that types other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements will be used when required by the current State or locally adopted building codes. Refer to Table 2 – Recommended School Lighting Levels for the recommended levels.

1. Types of Doors/Windows

Types of fenestration/glazing include:

- View windows
- "Top lighting" (high exterior windows with light shelves, clerestory windows, unit skylights, and tubular skylights)
- Entrance assemblies
- Interior and exterior doors
- Storefront systems

2. Construction Standards

a. Exterior Glazing and Windows

- Determine the design wind pressures applicable to the project according to "ASCE/SEI 7", based on heights above grade indicated on the drawings.
- Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

i. Aluminum Windows

- Comply with "AAMA/WDMA 101/I.S.2/NAFS", "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- Provide aluminum windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.

ii. Wood Windows

- Provide wood windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.

- Provide clad wood windows only.

b. Skylights and Tubular Skylights

i. Translucent Skylights

- Comply with "AAMA/WDMA 101/I.S.2/NAFS" "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- For acrylic glazing comply with "ASTM D 4802", thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber). Double glazed units only.
- Provide curb mounted type units.

ii. Tubular Skylights

- Comply with "AAMA/WDMA 101/I.S.2/NAFS", "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- Provide manufacturer's shading devices so classrooms can be darkened for presentations.

c. Interior Doors

- Provide AWI Quality Certification Labels or an AWI letter of licensing for the project indicating that doors comply with the requirements of the grades specified.
- Provide fire-rated wood doors that comply with "NFPA 80" that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at a positive pressure according to "NFPA 252".
- Provide vision panels where required for safety.

d. Exterior Doors

- Provide polyurethane insulated cores with a minimum of R-10.
- For cold-rolled steel sheet doors comply with "ASTM A 1008/A 1008M", Commercial Steel (CS), Type B; suitable for exposed applications.

3. Design Standards

Of all the high performance design features typically considered, none will have a greater impact on the school than day lighting. Not only can optimum day lighting design drastically reduce energy consumption, but it also creates healthier learning environments that may result in increased attendance and improved grades. Properly designed windows,

clerestories, and roof monitors can provide a large portion of lighting needs without undesirable heat gain, heat loss, or glare.

- Provide a total day lighting study for the proposed educational complex.
- Good day lighting strategies begin with proper building orientation and solar access.
- Consider day lighting strategies that primarily use north-facing glass and secondarily incorporates south-facing glass. Exposed eastern and western facing glass should be avoided wherever possible, because it will cause excessive summer cooling loads. South glass should incorporate properly sized shades/overhangs that limit radiation in warmer months.
- In cool and dry climates, it is important to consider how passive heating can provide benefits without negatively impacting summer cooling. Properly designed south-facing monitors or windows with light shelves can accomplish both.
- Lighting controls will be utilized. Lighting controls can ensure that students and teachers always have adequate light and that energy efficiency is maintained. Lighting controls can be as simple as multiple switches to full photocell controlled dimming controls. See the Electrical Systems section for controls.

4. Energy Standards

- The mechanical engineer shall complete the attached UA calculation spreadsheet for the building envelope system (located in Appendix A). The proposed total UA shall not exceed the target total UA. The target total UA is based on the areas and insulation values for each construction component using the code prescriptive path construction components.

5. Guidelines

The following guidelines should be followed on all interior partitions:

- Provide uniform light distribution.
- Provide low glare conditions.
- Reduce energy costs.
- Mitigate safety/security concerns.
- Provide low maintenance options.
- Provide day lighting that uses diffused or reflected sunlight where possible.
- Provide window views to help eye health and help reduce eye strain and stress.
- Encourage “top lighting” to provide best uniform illumination.
- Consider all academic spaces to have natural daylight.
- Minimize east and west facing glass where possible.

6. Doors/Windows

a. View Windows

i. Guidelines

- Provide deliberate connections to the outside environment so that changes in weather conditions are apparent as well as stimulating to students.
- Minimize the amount of view windows to minimize distractions.
- Avoid glare and direct beam radiation entering teaching and work spaces.

ii. Construction Standards

- Provide thermally broken window frames and high efficiency glazing systems. Glazing will be a minimum of double pane insulated glazing with Low "E" coatings. Use a minimum "U-value" of 0.45 and a shading coefficient of 0.40.

1. Aluminum Windows

- Comply with "AAMA/WDMA 101/I.S.2/NAFS", "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for definitions and minimum construction standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- Provide aluminum windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.

2. Wood Windows

- Provide wood windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.
- Provide Clad wood windows only.

b. "Top Lighting"

i. Clerestory Windows

1. Guidelines

- Avoid glare and direct beam radiation entering teaching and work spaces.
- Avoid creating high ceilings and large volumes in these types of daylight strategies.

- Provide light colored wall surfaces to maximize the light from these components.
- Provide north lighting conditions and avoid south facing clerestories.
- The most efficient means of appropriately restricting unwanted solar gain from entering glass areas is to block the radiation before it gets to the glazing.

2. Construction Standards

- Provide thermally broken window frames and high efficient glazing systems. Glazing will be a minimum of double pane insulating glazing with Low "E" coatings. Use a minimum "U-value" of 0.45 and a shading coefficient of 0.40.

a. Aluminum Windows

- Comply with "AAMA/WDMA 101/I.S.2/NAFS", "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- Provide aluminum windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.

b. Wood Windows

- Provide wood windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.
- Provide clad wood windows only.

ii. High Exterior Windows

1. Guidelines

- At exterior south or north facing walls provide high windows with light shelves and/or sun shades at the south exposures.
- Avoid glare and direct beam radiation entering teaching and work spaces.
- Provide strategies where the ceiling may slope from a high point at the exterior windows down to the interior corridor wall

planes. This will allow for deeper penetration of daylight into the classroom.

2. Construction Standards

- Provide thermally broken window frames and high efficient glazing systems. Glazing will be a minimum of double pane insulating glazing with Low "E" coatings. Use a minimum "U-value" of 0.45 and a shading coefficient of 0.40.

a. Aluminum Windows

- Comply with "AAMA/WDMA 101/I.S.2/NAFS", "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- Provide aluminum windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.

b. Wood Windows

- Provide wood windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for the project that pass "AAMA/WDMA 101/I.S.2/NAFS", Uniform Load Structural Test.
- Provide clad wood windows only.

iii. Unit Skylights

1. Guidelines

- Use insulated translucent type skylights.
- Use manufacturers that provide a complete system including curbing and flashings required for desired assembly.
- These types of daylight will not be utilized to provide direct daylight into the classrooms. These systems are superior in providing day lighting into larger interior spaces (i.e. dining commons, larger assembly areas, etc...).
- Provide mechanical ventilation to reduce condensation moisture created by these types of systems.
- Where it is functionally necessary, provide ways to reduce daylight through these units.

2. Construction Standards

- Comply with "AAMA/WDMA 101/I.S.2/NAFS" "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- For acrylic glazing comply with "ASTM D 4802", thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber). Double glazed units only.
- Provide curb mounted type units.

iv. Tubular Skylights

1. Guidelines

- These systems are ideal in providing additional daylight to the rear of deep classrooms. With a good day lighting strategy this type of skylight is not necessary in classrooms less than 28 feet in depth from the exterior window wall.
- Provide the ability to control the amount of daylight through these types of skylights.
- Tie the daylight control into a total room control system where necessary.

2. Construction Standards

- Comply with "AAMA/WDMA 101/I.S.2/NAFS", "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors" for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- Provide manufacturer's shading devices so classrooms can be darkened for presentations.

c. Entrance Assemblies

i. Guidelines

- Provide airlock vestibules at all main and active entrances. These vestibules should be deep enough to minimize the air infiltration into the building.
- Avoid large expanses of glazing.
- Floor to ceiling glazing is discouraged.

ii. Construction Standards

- Provide thermally broken window frames and high efficiency glazing systems. Glazing will be a minimum of double pane insulating glazing with Low "E" coatings. Use a minimum "U-value" of 0.45 and a shading coefficient of 0.40.

d. Interior Doors

i. Guidelines

- Provide wood solid core or high impact plastic laminate solid core doors for typical interior openings.
- Provide fire rated assemblies where required by the local building codes.
- Provide re-lights or sidelights where necessary for safety reasons.
- Provide commercial quality hardware with kick plates where required for abuse.
- Use painted hollow metal or knock down hollow metal frames for interior openings.

e. Exterior Doors

i. Guidelines

- Provide insulated metal painted doors or aluminum insulated, high usage type doors.
- Provide thermally broken frames where possible.
- Main entry doors may contain double pane insulated glazing. Try to minimize the amount of glazing proposed.

f. Store Front Windows

i. Guidelines

- Store front systems will be avoided unless they can be proven to be cost effective. Provide less costly solutions to larger view oriented glazing needs.
- Store front systems will only be used at main entrances and must be approved by a SFC representative. Provide the SFC representative with optional cost estimates of alternative glazing systems.

Wall and Ceiling Finishes

This section discusses recommended wall and ceiling finishes and their components. Other types of wall and ceiling finishes may be acceptable. It is recommended that any wall or ceiling finishes other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements will be used when required by the current State or locally adopted building codes.

1. Types of Finishes

- Types of wall and ceiling finishes include:
- Paints
- Stains and transparent finishes
- Vinyl-coated fabric wall coverings
- Specialty coverings/finishes
- Suspended acoustical ceilings or acoustical panels
- Acoustical wall treatments

2. Design and Construction Standards

- It is critical to coordinate the shop-applied prime coats with topcoats.

a. Maximum moisture content of substrates

When measured with an electronic moisture meter the maximum moisture content of the substrates is as follows:

- Concrete: 12 percent
- Masonry (Clay and CMU): 12 percent
- Wood: 15 percent
- Plaster: 12 percent
- Gypsum Board: 12 percent

b. Acoustical Tile Ceilings

- Use 2 feet by 4 feet product throughout the design. A 2 feet by 2 feet tile and grid are not acceptable. If the designer would like the effect of 2 feet by 2 feet style, use products that can attain this look.
- Avoid the use of expensive, single provider type products.

c. Acoustical Wall Treatment

- Use in assembly and music spaces where necessary.

d. Abuse-resistant Acoustical Panels

- Use only where normal abuse will take place.
- Use in gymnasiums and where normal abuse takes place.

3. Guidelines

These construction guidelines apply to all wall and ceiling finishes:

- Use materials easy to clean and maintain and are non-polluting (low VOC emitting).
- Use products made of recycled content.
- Consider initial costs and life cycle costs.
- Use products that can be repaired or replaced by local persons.
- Use products that are easy to install.
- Use products that provide good acoustical (sound absorbing) qualities.
- Use locally available materials.
- Use products that provide good light reflectance values of the walls and ceilings.
- Use wall and ceiling products or systems appropriate for the specific functional spaces with and acoustical properties.

4. Wall and Ceiling Finishes

a. Paints

i. Guidelines

- Provide elastomeric type exterior paint finish on all CMU or stucco finishes. Clear sealers that will eliminate moisture penetration through exterior materials will also be acceptable where integral product colors are preferred.
- Provide high quality, low VOC type paints that are easily cleaned and maintained.

ii. Construction Standards

1. Maximum moisture content of substrates

When measured with an electronic moisture meter the maximum moisture content of the substrates is as follows:

- Concrete: 12 percent
- Masonry (Clay and CMU): 12 percent
- Wood: 15 percent
- Plaster: 12 percent
- Gypsum Board: 12 percent

b. Stains and Transparent Finishes

i. Guidelines

- Provide high quality, low VOC type paints that are easily cleaned and maintained.

c. Vinyl-Coated Fabric Wall Coverings

i. Guidelines

- Provide identical wall coverings applied with identical adhesives to substrates according to the test method indicated below by a qualified testing agency. Identify products with the appropriate markings of applicable testing agency.

ii. Construction Standards

- Surface-Burning Characteristics, as follows, per "ASTM E 84":
    - Flame-spread index: 25 or less
    - Smoke-developed index: 50 or less

d. Specialty Coverings/Finishes

i. Construction Standards

- Provide products that comply with the limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
- Epoxy, cold-cured, gloss: MPI #77
- Water-based epoxy (interior and exterior): MPI #115
- High-build epoxy marine coating, low gloss: MPI #108

e. Suspended Acoustical Ceilings or Acoustical Panels

i. Construction Standards

- For acoustical panel colors and patterns, match the appearance characteristics indicated for each product type.
- Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in "ASTM E 1264" and not manufacturers' proprietary product designations, provide products selected by the architect from each manufacturer's full range that comply with the requirements indicated for the type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- Use 2 feet by 4 feet product throughout the design. A 2 feet by 2 feet tile and grid are not acceptable. If the designer would like the effect of 2 feet by 2 feet style, use products that can attain this look.
- Avoid the use of expensive, single provider type products.

f. Acoustical Wall Treatments

i. Construction Standards

- Use in assembly and music spaces where necessary.
- Use only where normal abuse will take place.
- Surface-burning characteristics, as follows, per "ASTM E 84":
    - Flame-spread index: 25 or less
    - Smoke-developed index: 50 or less

Interior Floor Finishes

This section discusses recommended interior floor finishes and their components. Other types of interior floor finishes may be acceptable. It is recommended that any interior floor finishes other than noted in this section receive early review and approval from a SFC representative. Construction standards indicated in this section are to be considered mandatory minimum requirements. More stringent requirements shall be used when required by the current State or locally adopted building codes.

1. Types of Interior Floor Finishes

Types of interior floor finishes include:

- Soft surface flooring
  - Vinyl composition tile (VCT) and vinyl enhanced tile (VET)
  - Sheet vinyl
  - Carpet and carpet tiles
  - Rubber flooring
- Hard surface flooring
  - Porcelain ceramic tile with recycled content
  - Quarry tile (QT)
  - Finished concrete (i.e. sealed, polished, or acid etched)
  - Ceramic tile (CT)
  - Resinous epoxy
  - Epoxy stone
- Athletic flooring
  - Wood flooring
  - Rubber flooring

2. Construction Standards

- Use water-based coatings and adhesives.
- Use nontoxic and non-polluting materials (low VOC).
- Use products resistant to moisture or inhibits the growth of biological contaminants.
- Use products that are easy to clean with non-polluting maintenance products.
- Use products durable to withstand heavy use without requiring frequent replacement.
- Use products that are easy to maintain.
- Provide moisture testing of concrete floors to meet the flooring manufacturer's requirements.

3. Guidelines

- Consider designing for the disassembly of a product and its parts to be reused, remanufactured, or recycled.
- Use products with good acoustical qualities.
- Consider recycled and/or recyclable.
- Use local (within 500 miles) materials and products where possible.
- Consider renewable materials products.
- Use products with a minimized PVC content.
- Use products that are economical. Consider life cycle evaluations when selecting flooring materials.
- Value engineer your choices before your final selection; consider function and life cycle cost.
- Provide "ENERGY STAR" compliant surface treatments.

a. Soft Surface Flooring

Types of soft surface flooring include:

- Vinyl composition tile (VCT) and vinyl enhanced tile (VET)
- Sheet vinyl
- Carpet and carpet tiles
- Rubber flooring

i. Guidelines

- Easy to clean and maintain.
- Provides acoustical benefits.
- Provides physical comfort (cushion).
- Uses recycled content and/or is recyclable.
- Provides safety for small children.
- Consider carpet that meets the Carpet and Rug Institute Green Label Plus criteria.
- Research and use carpet reclamation programs where available for disposal of existing carpet.
- Minimize PVC content where possible.
- Review life cycle costs including materials, cleaning, maintenance, and replacement.
- Consider designing for the disassembly of a product and its parts to be reused, remanufactured, or recycled.

- Use products with good acoustical qualities.
- Consider recycled and/or recyclable.
- Use local (within 500 miles) materials and products where possible.
- Consider renewable material products.
- Use products that are economical. Consider life cycle evaluations when selecting flooring materials.
- Value engineer your choices before your final selection; consider function and life cycle cost.
- Provide "ENERGY STAR" compliant surface treatments.

ii. Construction Standards

- For carpet use a minimum recycled content guideline of 25 percent, minimum 17 ounce face weight.
- Use low-VOC emitting materials. Resilient VOC content limited to 340 GM/liter or less.
- Use a maximum acceptable moisture emission rate for concrete sub floors:
    - Carpet and sheet vinyl – 3 pounds/1,000 square foot per 24 hours or less.
    - VCT – 3 pounds/1,000 square foot per 24 hours or less.
- Use water-based low VOC adhesives, sealants, and cleaning products.
- Use sheet vinyl with a backing of 0.080 inch thick.
- Use linoleum with a 0.10 inch (2.5mm) minimum thickness.
- Use water-based coatings and adhesives.
- Use nontoxic and non-polluting materials (low VOC).
- Use products resistant to moisture or inhibits the growth of biological contaminants.
- Use products that are easy to clean with non-polluting maintenance products.
- Use products durable to withstand heavy use without requiring frequent replacement.
- Use products that are easy to maintain.
- Provide moisture testing of concrete floors to meet flooring manufacturers' requirements.

b. Hard Surface Flooring

Types of hard surface flooring include:

- Porcelain ceramic tile with recycled content
- Quarry tile (QT)
- Finished concrete (i.e. sealed, polished, or acid etched)
- Ceramic tile (CT)
- Resinous epoxy
- Epoxy stone

i. Guidelines

- Easy to clean and stain resistant.
- Highly durable.
- Reasonably economical based on the life cycle cost analysis.
- Consider finishes and/or materials suitable for use in high traffic areas.
- Consider designing for the disassembly of a product and its parts to be reused, remanufactured, or recycled.
- Use products with good acoustical qualities.
- Consider recycled and/or recyclable.
- Use local (within 500 miles) materials and products when possible.
- Consider renewable materials products.
- Use products with a minimized PVC content.
- Use products that are economical. Consider life cycle evaluations when selecting flooring materials.
- Value engineer your choices before your final selection; consider function and life cycle cost.
- Provide "ENERGY STAR" compliant surface treatments.

ii. Construction Standards

- Use low-VOC emitting materials including flooring, adhesives, grouts, caulk or sealants.
- Comply with the ANSI ceramic tile standard.
- Mortars and grouts should be based upon the installation conditions and as recommended by the Tile Council of America.
- Use an epoxy-modified grout mixture for high moisture areas.
- For concrete floors use two components, either water-based, low odor, dust proofing, color pigmented epoxy sealer or stain.
- Use water-based coatings and adhesives.
- Use nontoxic and non-polluting materials (low VOC).

- Use products resistant to moisture or inhibits the growth of biological contaminants.
- Use products that are easy to clean with non-polluting maintenance products.
- Use products durable to withstand heavy use without requiring frequent replacement.
- Use products that are easy to maintain.
- Provide moisture testing of concrete floors to meet the flooring manufacturer's requirements.

c. Athletic Flooring

Types of athletic flooring include:

- Wood flooring
- Rubber flooring

i. Guidelines

- For wood flooring, use certified hardwood, salvaged wood, and/or laminated or veneered wood products where possible.
- For rubber flooring, verify compatibility of concrete curing compounds with the rubber flooring manufacturer.
- Consider designing for the disassembly of a product and its parts to be reused, remanufactured, or recycled.
- Use products with good acoustical qualities.
- Do not store materials outside.
- Consider recycled and/or recyclable.
- Use local (within 500 miles) materials and products where possible.
- Consider renewable materials products.
- Use products with a minimized PVC content.
- Use products that are economical. Consider life cycle evaluations when selecting flooring materials.
- Value engineer your choices before your final selection; consider function and life cycle cost.
- Provide “ENERGY STAR” compliant surface treatments.

ii. Construction Standards

- Wood gym floors:
    - Use a maximum 4.5 pounds per 1,000 square foot moisture emission in slab.

    - Provide a two year guarantee.
    - Second and better grade, maple strip flooring.
- Rubber gym floors:
    - Concrete shall be specified as American Concrete Institute Standard #117, Class AA Surface Finish B.
    - Use a maximum of 4 percent or less for the moisture content of the slab.
    - The room temperature shall be a minimum of 85 degrees Fahrenheit for one week prior to installation.
    - Provide a two year warranty.
- Use water-based coatings and adhesives.
- Use nontoxic and non-polluting materials (low VOC).
- Use products resistant to moisture or inhibits the growth of biological contaminants.
- Use products that are easy to clean with non-polluting maintenance products.
- Use products durable to withstand heavy use without requiring frequent replacement.
- Use products that are easy to maintain.
- Provide moisture testing of concrete floors to meet the flooring manufacturer's requirements.
- Movable bleachers need a wide wheel base as to not damage the floor.

Table 1 – Interior Floor Finishes

Room Types	VCT & VET	Sheet Vinyl	Carpet	Rubber Flooring	Porcelain Ceramic Tile	Ceramic Tile	Epoxy Stone	Quarry Tile	Finished Concrete	Resinous Epoxy	Wood Athletic Flooring	Rubber Athletic Flooring
Administration Areas	X	X	X		X							
Art Room	X	X							X			
Auditoriums			X						X			
Auxiliary Gyms			X	X							X	X
Cafeterias	X	X			X		X		X			
Commons	X	X		X	X		X		X			
Computer Rooms	X	X	X									
Concessions	X	X			X				X	X		
Conference Rooms			X									
Corridors	X	X	X				X		X			
Counselor Rooms	X	X	X									
Electrical Rooms									X			
Green Houses									X			
Gymnasium – Elementary School	X	X	X									X
Gymnasium – Middle & High School	X	X	X								X	X
Kiln Rooms	X	X							X			
Kitchens		X			X			X	X	X		
Life Skills/FACS Labs	X	X	X	X								
Locker Rooms				X		X[1]	X		X			
Maintenance/Janitors Rooms	X	X							X			
Mechanical Rooms									X			
Media Centers			X									
Multipurpose Rooms	X	X										
Music Rooms	X	X	X	X								
Nurse's Office	X	X	X									
Offices			X									
OT/PT Rooms	X		X									
Pantry/Food Storage	X	X							X			
Practice Music Rooms			X									
Reception/Waiting Areas	X	X	X	X								
Restrooms	X	X			X	X	X		X			
Science Classrooms	X	X	X						X			
Science Lab Rooms	X	X							X			

Room Types cont.	VCT & VET	Sheet Vinyl	Carpet	Rubber Flooring	Porcelain Ceramic Tile	Ceramic Tile	Epoxy Stone	Quarry Tile	Finished Concrete	Resinous Epoxy	Wood Athletic Flooring	Rubber Athletic Flooring
Science Prep Rooms	X	X							X			
Special Education Room			X									
Speech Rooms			X									
Stages (in High Schools)	X								X			
Stages/Platforms (in Elementary Schools)	X								X			
Stages/Platforms (in Middle Schools)	X								X			
Teacher Work Rooms	X	X	X						X			
Teacher Storage Rooms	X	X	X						X			
Typical Classroom	X		X									
Vestibules	X		X		X		X		X			
Voc Ed Rooms									X			
Weight Rooms	X		X	X					X			X
Wrestling Rooms	X			X					X			X

[1] Ceramic Tile only to be used in Locker Room Shower areas

Plumbing System

1. General Standards

This section establishes the minimum design requirements that must be met by the plumbing design professional. Minimum code requirements are the current edition of the IBC, IPC, IFGC, IECC, and NFPA. Local codes and construction standards may take precedence over these requirements provided said codes and construction standards are considered more stringent. School plumbing plans and specifications shall be prepared by a licensed professional engineer with a valid Wyoming registration.

- Provide quantity of plumbing fixtures to meet the International Plumbing Code (IPC) requirements.
- Select plumbing fixtures and provide access to meet American National Standards Institute (ANSI) Standards and ADA Accessibility Guidelines (ADAAG) for buildings and facilities.

2. Site Design Standards

- Determination of the available site services with regard to gas service, sanitary systems, storm water systems, domestic water system, and fire service system is necessary as a part of the site selection process.
- The building plumbing system design is to be complete to 5 feet outside the perimeter of the building foundation system and shall include all piping, fixtures, appurtenances, and appliances in connection with a supply of water (except for fire sprinkler systems), sanitary drainage, or storm drainage facilities within or adjacent to any building, structure, or conveyance on the premises. The connection to a utility water meter or other public water or sewer utility property or other source of water supply or sewage disposal and storm water structures shall be designed by the site utility design professional from 5 feet outside the perimeter of the building foundation system. Food service grease interceptors and gas piping and regulators shall be designed by the plumbing design professional.
- The plumbing design professional is required to evaluate the need and method to provide gas service to the building. All natural gas piping systems shall be installed in accordance with the IFGC. If natural gas service is not available, the installation of liquid propane gas shall be investigated. The estimated gas loads for operation of the heating water boilers, HVAC equipment, domestic water heaters, food service equipment, science program usage, and miscellaneous items are obtained from the appropriate disciplines by the plumbing design professional and totaled with the inclusion of a growth or safety factor. Discussion with the local gas company is necessary, both to determine potential service costs and to determine the responsibilities of the building owner and the gas company regarding the installation of the gas service and meter location. It is also important to determine the gas pressure requirements for the equipment in the building and communicate this need to the gas company. The plumbing design professional or site utility design professional shall design the gas service.

3. Plumbing Standards

a. Valving

- Valves shall be installed to isolate individual plumbing fixtures and groups of plumbing fixtures to permit shut down of the fixture or equipment item without affecting the remainder of the building.
- The domestic water system valves shall be bronze construction gate valves or full port ball valves.
- The gas supply to the science and art rooms shall have an emergency solenoid-type, automatic shutoff valve with a manual reset. The purpose of the valve is for the shutdown of the gas in case of an emergency or when the fire alarm system is activated. The option of an instructor control switch should be considered for controlling a gas solenoid to prevent unauthorized student use. The instructor's workstation should be piped prior to the control gas solenoid so that the instructor may demonstrate an experiment with gas while the gas at student workstations is turned off.
- The hot and cold water lab supply to the science rooms should be considered for a solenoid to prevent unauthorized student use. The instructor's workstation should be piped prior to the control solenoid so that the instructor may demonstrate an experiment while the water at the student workstations is turned off.
- A solenoid-type, automatic shutoff valve with a manual reset shall be installed to shut the gas off to the appliances under any Type I kitchen hood in the event there is a fire under the hood. The valves are normally designed closed and are held open by an electric solenoid valve. The valve shall be controlled by the kitchen hood fire suppression system.

b. Hangers

- Provide hangers for all horizontal, suspended, domestic, water, gas, sanitary, and storm piping with distances as noted in the state and local codes.
- Provide riser clamps for all vertical water, gas, sanitary, and storm piping passing through more than one floor as noted in the state and local codes.

c. Identification

- Piping shall be identified in mechanical rooms, unfinished spaces without ceilings, above suspended lay-in acoustical ceilings, and crawl spaces for the type of service and direction of flow. Equipment shall be identified with permanent, engraved name plates. Valves shall be provided with stamped, numbered tags (brass or aluminum) secured by chain or cable to the valve body or handle. A valve tag schedule shall be included in the Operation and Maintenance (O&M) Manuals. The valve tag schedule shall include the valve manufacturer, model number, and size.

d. Testing

- Domestic water, storm and sanitary sewers, and gas piping shall be pressure tested per state and local codes.

4. Potable Water System

- All buildings shall include a potable domestic water system serving all sinks, toilets, showers, food service, custodial needs, hose bibs, drinking water coolers/fountains, and HVAC plant systems. All municipal domestic water entering the building must pass through a reduced pressure backflow preventer to protect the outside water source from contamination in the building. The backflow device shall be located inside the building. A main pressure-reducing valve shall be provided if the incoming water pressure exceeds 75 psi. All backflow prevention devices shall be installed and maintained in accordance with the requirements of the AWWA, Department of Health, and the municipal water purveyor.
- Domestic water systems within the building shall be Type K or L copper tubing or PEX-A piping system with the approved PEX-A fittings.
- Water distribution throughout the facility will be through piping systems located above ceiling areas and below building envelope insulation. Piping installed under slab areas shall be avoided where possible. Slab on grade piping to island fixtures shall be installed in an accessible trench in the floor with a removable cover. PEX-A piping can be installed under the slab through a PVC conduit (minimum of 3 inch diameter). Water piping shall not be through crawl spaces unless the crawl space is part of the conditioned envelope.
- The required pressure for operation of the furthest fixture from the incoming service will determine if a pressure booster system will be required. The booster system should be a packaged unit that includes all controls. Provide a constant-speed duplex pump package with bladder-type compression tank to meet the flow requirements. It will be necessary to consider the installation of an emergency power system in order to maintain the operation of the booster system in the event of power outages, if the building is to be used during emergency-type occupancies. Coordination with the electrical design professional will be necessary. Minimum pressure required at the furthest fixture connection shall be 35 psi.
- Insulate all domestic cold water, hot water, and hot water recirculation piping to minimum requirements of the current IECC. Minimum insulation for all domestic water piping shall be ½ inch thick with a vapor barrier and sealed joints and fittings.
- A reduced pressure backflow preventer shall be provided for the water connection to HVAC systems and kitchen fixtures or other devices as required by state and local code.
- A double check backflow preventer shall be provided for the water connection to the irrigation water systems.

5. Domestic Water Heater System

- The following are acceptable domestic water heating designs for consideration:

- A series of staged instantaneous gas fired water heaters.
- Instantaneous water heaters with a storage tank.
- Tank-type water heaters for use in elementary school applications having no dishwasher facilities and no locker rooms.
- A point-of-use electric instantaneous water heater may be used for remote locations.

- A hot water return system with a re-circulating pump shall be required if the building hot water piping is more than 50 feet in length.
- Provide a separate hot water system for the kitchen or a water heater booster for the dishwasher.
- The on/off operation of the 120 and 140 degrees Fahrenheit domestic hot water circulation pumps shall be controlled by the time clock or the DDCS operation. A manual circuit setter shall be provided for each branch of the hot water circulation system for system balancing.
- Consider separate hot water systems for science labs.

6. Water Conditioning and Softening Systems Standards

- The water shall be tested for quality to determine the makeup of the water including hardness, mineral content, and chemicals. The installation of a water conditioning/softening system for domestic water systems, other than for full service kitchen, shall be directly related to the results of the water testing. A water system with a total hardness of less than 10 grains shall not include a softener system. Submit water test results for review and approval prior to incorporating water conditioning and softening systems into the design.
- If the grain hardness is above 10 grains per gallon (171 ppm), the water softener shall be sized to reduce the hardness to 10 grains, but never below 6 grains. Soften the hot water only.
- Water conditioning/softening systems shall be provided for full service kitchens for purposes of meeting the kitchen fixture/appliance warranty requirements. Conditioned/softened water to the kitchen shall be isolated from the rest of the facility water system when the water service has been tested with a total hardness of less than 10 grains.
- Review the water test results with school personnel before incorporating water softening in the design. A complete water conditioning system, including iron filters, may be necessary in the event the water has a high iron content from an on-site well system.

7. Sanitary Piping System Standards

- Allowable above grade piping materials shall include Schedule 40 PVC or ABS with solvent joints or cast iron no hub with approved hanger spacing. The use of PVC or ABS piping is prohibited when the HVAC system utilizes a return air plenum.

- Allowable below grade piping materials shall include Schedule 40 PVC or ABS with solvent joints or cast iron no hub.
- Fill material around the piping below the slab shall be compacted granular material to 95 percent-modified proctor.
- Piping shall not be installed parallel/directly under walls. Coordinate pipe routing with the structural footings.
- Fixtures in secondary school science spaces shall be piped with Schedule 40 polypropylene acid resistant piping from the fixture to a 1 quart glass bottle trap. The wasted piping from the bottle trap to the sanitary main shall be as described above.
- Locate waste cleanouts within the building in the walls whenever possible.
- Provide a cleanout to grade within 5 feet of the building exterior. Avoid locating the cleanout in concrete walkways.
- Provide a food service grease interceptor for full service cooking kitchens. Connect all drains that may accept grease including 3-compartment sinks, dishwasher floor sinks, and floor drains/trench drains in the cooking and clean-up areas. Verify other connection requirements with the local jurisdiction. Provide a grease interceptor properly sized for the kitchen load. The vault shall contain two man holes with ladders for access. Provide an inspection clean-out downstream from the vault prior to connection to the sanitary main when required by local jurisdiction. Food service grease interceptors shall be designed by the plumbing design professional.
- Provide information to the site design professional as to the depth of the sewer(s) exiting the building. Provide information to the structural design professional as to the location and depths of the sewer in relationship to footings and columns as they pertain to the project. Coordinate above grade waste piping with structural steel members.

8. Gas Piping Systems Standards

- Gas piping shall be Schedule 40 black steel with screw fittings for piping 2 inches or less and welded fittings for piping 2 ½ inches or larger.
- Gas piping in plenums shall not contain valves or unions.
- A gas regulator shall be provided at the service meter or to each gas appliance to maintain the correct inlet pressure. The inlet and outlet piping to each regulator shall be valved with IFGC approved valves. Gas regulators located within the building shall be vented to the exterior with full port-sized piping.
- The maximum gas pressure into the building shall be as established by the local gas company. Provide the gas company with the building gas loads for each load type (i.e. HVAC, water heating, science, etc...), and the minimum and maximum operating pressures for each appliance early in the design process.
- Gas piping to island counters shall be in an accessible trench in the floor with a removable cover or in a sealed conduit vented to the exterior of the building.

- Provide a valve and a dirt leg at each appliance connection.
- Hard pipe to each gas appliance. Flexible connectors shall not be permitted except for connections to kitchen appliances.
- Natural gas piping to island sinks/counters shall be in an accessible trench in the floor with a removable cover or in a sealed conduit vented to the exterior of the building.
- LP systems shall be designed by an experienced plumbing designer. LP gas piping shall not be concealed. Design to meet the NFPA and IFGC code requirements.

9. Roof Drain and Storm Sewer Systems Standards

- Piping materials shall include Schedule 40 PVC with solvent joints; cast iron, no hub.
- Fill material around the piping below the slab shall be compacted granular material to 95 percent-modified proctor. Piping shall not be installed parallel/directly under walls.
- Piping above grade shall be cast iron, no hub, with approved hanger spacing. Coordinate pipe routing with structural footings.
- Provide connections to all roof drains.
- Provide insulation for all roof drains, rain water leaders, and overflow leaders.
- Provide information to the site design professional as to the depth of the rain water leaders exiting the building. Provide information to the structural design professional as to the location and depths of the rain water leaders in relationship to footing and column pass as they pertain to the project.

10. Building Fire Protection Systems Standards

- Some building construction may not require building fire protection systems. Coordinate construction type and fire protection systems with the architect. All other buildings shall have a complete fire suppression (sprinkler) system throughout in accordance with NFPA 13, 14, and 20. Available static water pressure, residual pressure, and water flow must be evaluated as a part of this determination.
- Installation of a water storage system along with the fire pump installation may be required where insufficient water, flow, and pressure are present.
- A backflow preventer of type required by the local AHJ shall be included on all incoming systems.
- Coordinate with the local AHJ for the location of the fire department connection and post indicator valve.
- Dry type fire suppression systems for IT rooms may be considered. If a dry type fire suppression system is used, coordinate with the electrical engineer for electrical and fire alarm requirements.

11. Radon Piping Systems Standards

- Provide a passive radon mitigation system design meeting the EPA's Radon Mitigation Standards for schools. The passive radon mitigation system shall consist of a pipe run within the aggregate under each concrete slab. The minimum pipe diameter shall be 3 inches unless otherwise approved. Acceptable sealed plastic pipe shall be smooth walled and may include either PVC schedule 40 or ABS schedule of equivalent wall thickness. The pipe shall be continuous and permanently sealed above the slab and shall terminate no less than 12 inches above the eave and more than 10 horizontal feet from any fresh air opening into the building. The continuous sealed pipe shall be labeled "radon vent". Label pipe in concealed and exposed areas above grade. The entire sealed pipe system shall be sloped to drain to the sub-slab aggregate. The passive radon mitigation system shall be designed to allow the addition of a radon fan if the building is ever tested with a result 4 pCi/L or more. Coordinate future power requirements with the electrical engineer.

12. Plumbing Fixtures and Specialties Standards

- Water closets shall be vitreous china, white, battery, or hardwired infrared flush valve, wall hung, and low water consumption type. Manual dual consumption flush valves should also be considered.
- Tank type floor mounted water closets shall be vitreous china, white, hand operated, and low water consumption type with a pressurized flush tank.
- Urinals shall be vitreous china, white, battery or hardwired infrared flush valve, wall hung or floor mounted, and low water consumption type. Ultra-low-flow or waterless urinals should be considered with the pros and cons discussed with the owner and the architect.
- Lavatories shall be wall or counter mounted vitreous china. Single use restrooms shall have cast brass hand operated faucets or battery or hardwired infrared faucets. Public restrooms shall have cast brass battery or hardwired infrared faucets. Temperature control shall be integral with the faucet or remote mixed. Battery operated units shall have battery replacements accessible from above the countertop.
- Consider the use of gang sinks in public restrooms to minimize space and fixture requirements.
- Showers shall be the low water consumption, pressure-balanced type. Showers shall have a hot and cold, single lever pressure balancing valve with a vandal-resistant head. Gang showers shall be provided with a blending valve to provide a single temperature tempered water.
- Drinking water coolers/fountains shall be refrigerated and conform to ADA standards.
- Classroom sinks in elementary schools shall be single compartment, 18-gauge, 302 or 304 stainless steel with a fixed gooseneck faucet and a deck mounted bubbler. Typical classrooms for middle and highs schools shall not have classroom sinks.
- Break room sinks shall be double compartment, 18-gauge, 302 or 204 stainless steel with an adjustable gooseneck faucet.

- Science lab sinks shall be connected with acid-resistant material. The science casework manufacturer shall provide sinks. Waste piping shall be piped with Schedule 40 polypropylene acid resistant piping from the fixture to a one quart glass bottle trap. The wasted piping from the bottle trap to the sanitary main shall be as described in Part 6 of this section.
- Large group restrooms shall be provided with lavatories or a comparably sized wash fountain with infrared sensing or manual operation.
- All plumbing fixtures and trim designed or designated for use by the handicapped shall meet the ADA guidelines.
- Water supply (hot and/or cold) to the lavatories, sinks, and drinking fountains shall have angle stops with loose key handles. Supply piping shall be chrome plated, soft drawn copper. Flexible hose supplies shall not be permitted.
- Lavatory and sink tail piece and P-trap shall be 18 gage chrome-plated brass or copper. Plastic or PVC tail pieces are not acceptable.
- All lavatories, water closets, and urinals that are wall mounted shall have wall carriers.
- Floor drains shall be installed in each restroom (except single person toilet rooms), locker rooms, mechanical rooms, and kitchen areas. Provide a sediment bucket in the floor drain if conditions exist where solids may enter the drain. Provide full flow funnels for drains serving plumbing or HVAC equipment.
- Sanitary and storm sewer cleanouts shall be installed at 50 feet on center inside the building, at changes in direction of 90 degrees or more, at the bottom of vertical risers, and as the sewer exits the building. Locate cleanouts in walls when feasible.
- Service sinks shall be floor-mounted, molded stone, 10 inches high, with a wall-mounted faucet with a bucket bracket. Provide a hose hanger and a stainless steel back splash.
- Install a cold water hose bib in each large group restroom, locker room, and mechanical room. The hose bib shall include a vacuum breaker and shall be surface mounted behind a lockable door in restrooms and locker rooms with access by a removable key handle.
- Reduced pressure backflow preventers are required on the water supplies to each HVAC makeup water system and kitchen fixtures or other devices as required by state or local code.
- A water pressure reducing station requiring 2 pressure reducing valves sized for 1/3 and 2/3 flows shall maintain the water pressure in the building to a maximum of 75 psi, if the incoming water pressure can exceed 75 psi.
- Clay traps shall be provided in art rooms to prohibit clay and solids from entering the sanitary sewer. The clay trap shall be accessible to clean out the trap.
- Vent systems shall be installed and properly sized. Trap primers or trap guards shall be required for all traps inside the building and shall be accessible for repair.

13. Closeout Documents Standards

- O & M manuals shall be provided in duplicate for the School District. Manuals shall contain approved shop drawings, operations and maintenance instructions, and parts manuals for all plumbing fixtures and equipment. The O&M manuals shall be assembled and organized to follow the order of specification sections
- The contractor shall provide as-built mark up plans to the design engineer for transferring to electronic AutoCAD files. Provide the School District with two sets of CD's with AutoCAD files and PDF's of all plumbing plans. Provide individual PDF files for each drawing. Mark each plan with "RECORD DRAWING" and indicate the date the drawings were produced.

HVAC System

1. General Construction Standards

The heating, ventilating, and air conditioning system design standards criteria denoted as a part of these Design Guidelines have been developed or are obtained directly from accepted engineering design references such as the ASHRAE handbooks and standards, ASHRAE Advanced Energy Design Guide for K-12 School Buildings, and good engineering practices. School HVAC system plans and specifications shall be prepared by a licensed professional engineer with a valid Wyoming registration. The HVAC design professional should review each requirement and obtain or develop the necessary information for each specific building before proceeding with the systems design.

All systems shall be designed in compliance with ASHRAE Standard 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings". Minimum code requirements are the current edition of the IBC, IMC, IPC, IFGC, and IECC.

2. System Selection Life Cycle Cost Standards

Provide an Energy Life Cycle Cost Analysis (ELCCA) Work Plan for approval with the 10% Value Engineering design submittal (see Appendix B for a copy of the ELCCA Work Plan). The work plan is an outline of what the analyst intends to accomplish with the ELCCA report and shall include any requests for variations from the guidelines for HVAC systems.

The work plan shall include a description of the building and participants and reflect the planned analysis for each building component and energy system to be addressed in the ELCCA including:

- building envelope,
- lighting systems,
- domestic hot water,
- mechanical system alternatives,
- building control systems, and
- renewable, alternative, and high performance energy systems.

Several HVAC systems are applicable to Wyoming schools. System selection shall be based on a life cycle cost analysis of a minimum of three distinctly different alternative systems, a renewable alternative, and a high performance building alternative. The requirement for the System Selection Life Cycle Cost Analysis applies to new construction, including new buildings, additions to existing buildings, and the replacement to upgrade HVAC units in existing buildings when the cumulative cooling tonnage exceeds 16 tons.

The mechanical systems evaluated in the ELCCA must be distinctly different and not be a variation of the same system. Examples of the distinctly different mechanical system alternatives to be evaluated include but are not limited to:

- 4 pipe fan coils
- Water source heat pumps
- Central station VAV

Similar mechanical systems can also be evaluated to determine if an enhancement of that system is justified. This type of analysis is encouraged as it can be helpful to the design team to make system decisions but cannot be considered to meet the requirements of evaluating distinctly different mechanical systems. System enhancement examples are below.

- Example 1
    - Water source heat pumps coupled with a boiler and a cooling tower
    - Water source heat pumps coupled with open wells (pump and dump)
    - Water source heat pumps coupled with a closed vertical well field
- Example 2
    - Central station VAV without energy recovery
    - Central station VAV with energy recovery

Envelope enhancements beyond code prescriptive levels shall also be included in the ELCCA and compared to a baseline system.

Mechanical Space: Differences in mechanical space requirements for alternate mechanical systems considered shall be economically evaluated in the ELCCA. This shall include additional floor space and additional building volume.

The ELCCA shall include but should not be limited to the evaluation of energy efficient construction options, the use of sustainable construction material options, energy efficient mechanical equipment options, and lighting and day lighting options.

The following are examples of acceptable programs for use in generating a detailed evaluation of proposed heating, ventilating, and air conditioning systems. Further, the building load calculations necessary for the design of each building will require the use of computer-generated data. Equivalent computer programs that are able to generate the necessary data for evaluation of the proposed heating, ventilating, and air conditioning systems and for generation of the building load data will be considered, but must be submitted for approval in writing with the work plan prior to use.

- Trane Trace 700 (most recent version of Trane Trace)

  The Trane Trace 700 program is a PC based program used by the HVAC design professional for generation of detailed building system air conditioning loads, energy consumption analysis, and economic analysis. The current version can be obtained from the Trane Company, Customer Direct Service (CDS) Network, La Crosse, WI, 608-787-2000.

- Carrier HAP (most recent version of Carrier HAP)

The Carrier Hourly Analysis Program is a PC based program used by the HVAC design professional for generation of detailed building system air conditioning loads, energy consumption analysis, and economic analysis. The current version can be obtained by contacting the local Carrier equipment representative or by calling Software Systems Network, Syracuse, NY, 315-432-7072.

- DOE-2.E (most recent version of DOE-2)

  The DOE-2.E is a detailed energy analysis program developed through the United States Department of Energy. A number of vendors across the country have developed software that operates to meet the intent of the DOE-2.E program.

Occupancy loads and schedules shall reflect the actual expected building usage and schedules. Input occupancy shall be calculated at 90 percent of scheduled capacity during normal school hours for classroom areas and the administration area. After hours occupancy can be considered negligible in these areas. Activity areas such as gymnasiums and auditoriums should be calculated at no more than 25 percent of the full load capacity during unoccupied operation. Variations to this analysis concept will be considered upon written request with explanation and justification of change. Variation requests shall be submitted with the work plan.

Lighting systems shall be included in the analysis. The lighting densities shall be consistent throughout the building for each space type. The lighting load shall be input for consideration as a cooling load only, and shall not be used to credit the winter heating load. Lighting load densities shall comply with the latest edition of the International Energy Conservation Code. The HVAC design professional shall coordinate and review proposed lighting requirements for each building with the electrical design professional prior to generating a final energy load analysis. Usage of the lighting systems should reflect the occupancy scheduling for each area in the building.

Computer locations and expected usage should be taken into consideration for all classrooms, computer labs, and media rooms. Include a minimum of 280 watts for each computer station in the applicable space. This load includes the total expected heat gain for a desktop computer and LCD monitor.

3. Energy Life Cycle Cost Analysis (ELCCA) Report

The Life Cycle Cost Analysis Report shall include:

a. Executive Summary

b. Energy Simulation (Model) Assumptions

c. Economic Assumptions

d. Building Envelope

e. Lighting Systems

Provide an analysis of available rebates and incentives from local utilities and/or other applicable agencies for the mechanical and electrical systems analyzed. Include mechanical and electrical utility rebates and incentives in the cost estimates for each applicable system type.

See Appendix B for an ELCCA report outline and instructions and examples for preparing the ELCCA report.

4. Outdoor Air Design Temperature Standards

- Summer and winter outside air design values shall be derived from standard ASHRAE compiled weather data located in the latest edition of the ASHRAE Fundamentals Handbook. The city nearest the proposed construction project is to be selected for evaluation. Use the 99.6 percent design values for heating design dry-bulb and the 1 percent design values for cooling design dry-bulb and mean coincidental wet-bulb. To determine the maximum ventilation capacity, use the 1 percent design values for Humidification design dew point and mean coincident dry bulb. Any variations from this method must have prior written approval.

5. Indoor Air Design Temperature Standards

- Indoor air temperature design values must reflect the need for energy conservation and shall comply with the latest edition of the International Energy Conservation Code.
- The design shall produce indoor conditions in accordance with ASHRAE Standard 55 “Thermal Environmental Conditions for Human Occupancy”.
- Night setback controls shall be used for all systems. Per ASHRAE, the recommended winter setback temperature is recommended at 55 degrees Fahrenheit (warmer night setback temperatures may be necessary in extreme cold winter conditions but should be no higher than 65 degrees Fahrenheit). The ASHRAE recommended summer setback temperature is 80 degrees Fahrenheit. In areas where summer humidity may be an issue, the temperatures shall be set to operate as required to maintain a relative humidity in the building area that does not exceed 60 percent. Maintaining humidity levels below 60 percent will result in the periodic operation of the HVAC system during the summer months to reduce the potential for mold and mildew in the building.

6. Indoor Air Quality Standards

- Indoor air quality shall meet the requirements of ASHRAE Standard 52.2 and ASHRAE Standard 62.1. Air filtration for low pressure HVAC systems shall meet a minimum rating MERV 7. Air filtration for medium and high pressure HVAC systems shall meet a minimum rating MERV 11.
- Consider the local environmental conditions when designing for indoor air quality. Provide necessary additional filtration or air treatment to reduce/eliminate unpleasant and/or harmful odors from entering the building ventilation system.
- For duct systems using a duct liner, specify antimicrobial coated liner.
- Consider the use of Ultra Violet (UV) filtration.
- Building renovations and additions that are to be under construction during building occupancy shall incorporate specification requirements based on SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

7. Outdoor Air Ventilation Standards

- Outdoor ventilation rates shall be calculated for each occupied space and shall conform to the requirements of the International Mechanical Code or be calculated using the ASHRAE 62.1 method. Ventilation rates shall be based on actual expected occupants for each space and not the code maximum occupancy per square foot. However, the occupancy used for ventilation calculations shall not be less than 50 percent of the code occupancy per square feet.
- Each system shall include controls for a 100 percent economizer cycle to cool the building when dictated by the IECC.
- Energy recovery shall be used as a part of the design for classroom, gymnasium, locker room, and student dining systems when simple payback is less than eight years to reduce the energy consumption required, providing the necessary outdoor ventilation rates, or when dictated by the IECC.
- Carbon dioxide levels shall be monitored through the direct digital temperature control system for proof of system operation to maintain carbon dioxide levels in large transient occupancy spaces, as recommended by ASHRAE Standard 62. The use of space specific carbon dioxide sensors are recommended for this operation.
- Occupancy sensors shall be used to turn off ventilation to classrooms when rooms are sensed as unoccupied for a period of 15 minutes. When no occupants have been sensed in the space for 30 minutes, the fan or terminal box serving the space shall shut down and go into an unoccupied mode until occupants are sensed in the space again. Use a programmable schedule to provide morning warm up or cool down sequences; do not use occupancy sensors to provide the regular start up for each occupied period.

8. Temperature Control System Standards

- All temperature control systems installed shall be direct digital controls system (DDCS). Pneumatic control systems will not be permitted for new construction or major renovation projects. Each facility will be provided with the means to access the control system software with a desktop or laptop computer. Remote access into the DDCS shall be via internet. It will be necessary for the HVAC design professional to advise the school district of the options for control and management of the building available through the DDCS.
- Thermostatic zoning shall be developed using good engineering practice. Dissimilar spaces shall not be grouped on the same thermostat. Each classroom shall be on an independent zone. Other zones may also be required to be separately thermostatically controlled. Carefully review space requirements for these for proper zoning. Occupied/unoccupied scheduling shall be based on the associated air handling system. Each thermostat zone associated with a digital control shall have a means to override the schedule for temporary occupancy.
- The DDCS shall be capable of performing time of day scheduling, night set-back, holiday scheduling, and demand limiting.

- The ventilation system control shall be set through the central direct digital controller based on global outside air temperature and humidity to maintain indoor relative humidity below 60 percent. Mechanical humidification systems shall not be designed without prior approval.
- The DDCS shall be designed to place emergency calls to designated school personnel in the event of critical equipment failure.
- Set up the DDCS to shut down all 3-phase equipment upon electrical system loss of phase.
- Options shall be investigated with each direct digital control system for the operation of exterior, corridor, and restroom lighting systems through the energy management computer.
- The DDCS shall be set up with trend logs for space temperatures, HVAC system components runtime, and system user interface overrides. The design professional shall discuss other possible trend log requirements with the owner. Specify that the controls contractor will provide training for the owner on all aspects of the DDCS.
- Provide DDCS diagrams and sequences of operation on drawings. Identify which equipment is applicable to each diagram.

9. Interior and Exterior Noise Control

- Interior HVAC acoustic design shall not cause indoor sound levels to exceed NC30.
- Classrooms shall be designed for best practices to obtain a maximum of 45 dBA.
- The location of exterior mechanical equipment shall be reviewed by the design professional for its sound impact, both inside and outside the building.
- Consider mitigation of sound and vibration for mechanical equipment over 15 tons cooling capacity by inclusion of a sound package, vibration/acoustical curb, and duct silencers. Evaluate the possibility of low frequency noise and vibration.
- Consider mitigation for sound for mechanical equipment located over spaces not finished with acoustical ceiling panels such as gymnasiums, auditoriums, and commons. Do not locate rotating machinery above classrooms.
- Specify fans over 5 HP with spring isolators.
- Exterior equipment operation shall not cause indoor sound levels to exceed specified levels for the space.
- Exterior sound levels shall be in compliance with the local governmental ordinances. When these values are not governed, the sound level created by the equipment shall not exceed 70 dB measured at the property line.

10. Gymnasium/Locker Room Standards

- Gymnasiums are to be heated and ventilated without mechanical cooling. If mechanical cooling is desired by the school district, it shall be considered a district enhancement.

- Ductwork in gymnasiums shall be designed/coordinated to be installed within the structural truss space (above the bottom cord) to prevent interference with educational programming space height requirements.
- Ventilation systems must provide 10 air changes per hour.
- Ancillary spaces such as offices and locker rooms shall be served by separate HVAC systems and may include mechanical cooling. Energy recovery shall be considered for locker rooms.

11. Kitchen HVAC and Make-up Air Standards

- The kitchen's primary HVAC system shall be sized based on the occupants and envelope only and shall exclude the make-up air for the kitchen hoods.
- Make-up air for the kitchen hoods shall be provided by transferring air from an adjacent, freely communicating space or by a separate make-up air unit in accordance with the IBC and IMC. A heating and ventilation unit can be provided with evaporative cooling if desired. Mechanical cooling is not permitted.
- Provide a diagram of the exhaust and ventilation system interlock requirements. Include interlocks with the fire suppression system for Type I hoods.

12. Science Lab Space Standards

- Provide exhaust for fume hoods as applicable per educational programming requirements.
- Provide general room exhaust with two speed fans. Low speed for general class use during experiments and a high (purge) speed for temporary use to quickly clean out room air. Provide user controls with three position wall switch.
- Do not allow recirculation of air from science rooms with other classrooms.
- Prep rooms and chemical storage rooms to be provided with continuous exhaust with exhaust outlets at the ceiling and near the floor.
- Coordinate with the science programming for necessity of corrosion resistant or explosion proof exhaust fan/duct systems.

13. Equipment Accessibility Standards

- Access and service space for mechanical equipment shall be in accordance with the IBC and IMC.
- Consider feasibility of access to all components of the mechanical equipment including interferences with other equipment, structure, and obstacles. Make sure rooftop equipment is located at a minimum of 10 feet from the parapet.

14. Mechanical Room Standards

- Mechanical rooms are to be coordinated with the architect for the size and location. The size and location shall be appropriate for the mechanical system type.

- Consider space requirements for repair and replacement of all HVAC components. Second floor boiler rooms are not recommended.
- Differences in mechanical space requirements for mechanical system alternatives (floor area and building volume) shall be economically considered in the ELCCA.

15. Closeout Documents Standards

- O & M manuals shall be provided in duplicate for the school district. Manuals shall contain approved shop drawings, operations and maintenance instructions and parts manuals for all HVAC equipment, equipment start-up sheets, commissioning report, and test and balance (TAB) report. The O&M manuals shall be assembled and organized to follow the order of specification sections.
- The contractor shall provide as-built mark up plans to the design engineer for transferring to electronic AutoCAD files. Provide the school district with two sets of CD's with AutoCAD files and PDF's of all mechanical plans. Provide individual PDF files for each drawing. Mark each plan with "RECORD DRAWING" and indicate the date drawings were produced.

Electrical Systems

1. General

All electrical work shall be executed in strict accordance with the latest edition of the following construction standards and codes and all local ordinances and regulations.

- NFPA - National Fire Protection Association
- ANSI C2 - National Electrical Safety Code
- NEMA - National Electrical Manufacturers Association
- UL - Underwriters Laboratories
- All systems shall be designed in compliance with the current ASHRAE Standard 90. 1 "Energy Standard for Building Except Low-Rise Residential Buildings".

2. Guidelines

The following sections provide guidance for developing a high quality electrical system that balances flexibility, long life, and system costs.

a. Distribution

- Electrical systems distributed throughout the building shall be based upon the 480-volt or 208-volt, three-phase, grounded wye configuration except electrical system extensions in existing buildings may match existing criteria.
- Transient voltage surge protection devices shall be located on main service distribution equipment and on branch circuit panels serving electronic equipment.
- Lightning (arrester and protection) devices shall be located on the building and the main service distribution equipment where weather conditions warrant it or as required by the IBC.
- Current carrying conductors shall be a minimum No. 12 American Wire Gauge, except for systems wiring such as fire alarm, data, telephone, etc... Conductors shall only be copper. Conductor size No. 12 and No. 10 must be solid type, except where flexibility is required, such as at motors. Conductors larger than No. 10 shall be stranded. Aluminum lugs for terminating copper conductors are acceptable, if labeled for that purpose.
- Current carrying conductors shall be installed in conduit systems conforming to the National Electrical Code's latest edition.
- Continuous equipment grounding conductors shall be installed in all circuits bonded to all ground lugs, bussing, switches, receptacles, equipment frames, etc..., per the National Electrical Code. The main facility grounding field electrode system to ground shall be 5 ohms or less.

- Electrical systems main service equipment shall be designed with a minimum 25 percent spare amperage capacity and 20 percent spare space capacity. Panel board loads shall not exceed 75 percent of amperage capacity and each panel shall be provided with a minimum of 6 spare over current protection devices. Provide spare over current protection devices in all panel boards. Provide space for future circuit breakers in switchboards and switchgear.
- Electrical distribution equipment shall be located in dedicated electrical or mechanical rooms. Main electrical service (switchboards) distribution equipment shall not be located in the main heating or cooling generating room. Branch circuit panel boards recessed in corridor walls will not be acceptable.
- Dry type transformers shall be the NEMA TP-1/TP-2 compliant energy efficient type with copper windings.
- Electrical branch circuits to 5 horsepower, 3-phase, and larger motors for air-handling units, exhaust fans, pumps, chillers, and condensing units shall be provided with phase loss protection. Protection shall prevent equipment from single phasing. Phase loss protection equipment shall be integral to starters or variable frequency drives serving the equipment.
- The intent of connecting emergency power to selected components of the HVAC system is to provide an opportunity to limit damage from freezing weather during a power outage of short duration. The following components are not required to be connected to the emergency power source and are optional within budgets:
    - Air handling unit pre-heat coil (heating coil)
    - Cooling tower basin heaters
    - Chilled water circulating pump when used for chiller freeze protection; independent, separate raceway, wiring, and transfer switches shall be provided for emergency life safety systems and non-emergency life safety systems
- Consider running all branch circuit and feeder conduits within buildings above the ceilings and within walls. No conduits are permitted in or below slabs unless serving a device or millwork that requires it. Conduit shall be ¾ inch minimum trade size except conduit to switches may be ½ inch.
- PVC conduit is not allowed except for the underground portion of the incoming utility service to the buildings. It must then be encased in 3 inches of concrete. All elbows and risers to 6 inches above finished floor in PVC conduit runs must be rigid steel. PVC elbows are not allowed.

b. Wiring Devices

- General purpose use, 120-volt duplex receptacles shall be specification grade, 20 amp, standard grounded type.
- Separate receptacles located within instructional spaces shall be provided for general purpose uses and for computer/video technologies.

- Instructional spaces shall be provided with ample general use receptacles, as well as double duplex receptacles next to computer/video technologies ports.
- Each space or room shall be provided with a minimum of 1, 120-volt receptacle.
- General purpose receptacles in corridors shall be spaced a maximum of 50 feet apart.
- Office areas, conference rooms, and teacher workrooms shall be provided with ample receptacles.
- A maximum of 4 computers shall be on a single 20-amp, 120-volt electrical circuit with a dedicated ground and neutral. Do not share computer circuit neutrals with other branch circuits.
- Provide an exterior, weatherproof ground fault protected duplex receptacle outside each main exterior door.
- Electrical receptacles serving food service equipment not located against walls shall be mounted above the floor line on pedestal type mountings.
- Kindergarten classrooms and their auxiliary spaces shall have duplex, tamper resistant receptacles installed.
- Receptacles shall be side wired using pigtails. Back wiring or thru-wiring on device terminals is not acceptable.
- Avoid the use of floor recessed power/data outlets where possible.

c. Interior Lighting

See Table 2 – Recommended School Lighting Levels at the end of this section for recommended lighting levels.

- Interior instructional spaces shall be artificially illuminated with energy-efficient and high-efficiency fluorescent light fixtures utilizing electronic ballasts. Lamps shall be fluorescent T8 or T5.
- High volume spaces such as gymnasiums, student dining, etc..., shall be illuminated with high-efficiency, high-intensity discharge (HID) lamp type light fixtures or T5HO high output fluorescent luminaries. Fluorescent luminaries are recommended over seating areas. Where HID lamps are used, quartz restrike options shall be incorporated into some fixtures to provide illumination during the cool-down/warm-up (restrike) period caused by momentary electrical outages.
- The minimum illumination (foot-candle) levels shall conform to the established Illuminating Engineers Society of N.A. guidelines. (See Table 2 – Recommended School Lighting Levels at the end of this section). Foot-candle calculation shall be developed by using the room cavity ratio method or by the point-by-point method with work plane surface being 30 inches above the floor.

- Emergency means of egress lighting shall be provided per local and NFPA Code requirements. The following areas shall have emergency illumination whether having natural illumination or not:
    - Exits and exit access corridors
    - Small and large assembly areas
    - Locker rooms
    - Student restrooms
    - Main and other dedicated electrical rooms
    - Main mechanical room and other mechanical decks
    - Emergency power equipment locations
    - Administration and other building control areas
    - Kitchen/student dining
    - Interior instructional space without natural illumination
    - Rooms with occupant loads over 50 people
    - Exterior side of exterior exit doors
- Power to emergency lighting shall be through batteries, except in larger facilities where a generator may be used. If a generator is proposed, a life cycle cost analysis between battery and generator power shall be completed by the engineer to justify the use of a generator.
- Computer labs shall be illuminated with recessed direct/indirect fluorescent fixtures with perforated lens or linear pendant fluorescent direct/indirect fixtures suitable for computer screens.
- Fluorescent lighting in instructional spaces shall be oriented and/or provided to illuminate the chalkboard or the primary instructional wall unless design parameters suggest otherwise.
- Light fixtures located in gymnasiums and auxiliary gymnasiums shall be equipped with protective wire guards.
- Exit signs shall be wall mounted, where possible, instead of ceiling mounted and be of the LED type.
- Art rooms with art display areas should be provided with supplemental incandescent lighting to depict colors accurately.
- "Night lighting" shall be provided in gymnasiums and larger assembly spaces to allow safe access without the need for full illumination.
- Options shall be investigated for the control of exterior and interior corridor lighting by direct digital control by the energy management system.

d. Interior Lighting Control

- Interior lighting shall be controlled by occupancy sensors, relay based lighting controlled systems, relay override switches, line voltage override switches, or a combination to comply with ASHRAE 90.1. Daylight harvesting or other complicated lighting control systems are discouraged. Lighting control programming shall be setup to activate relays and/or lights with occupancy (no "on" programming) by activation of a relay override switch or occupancy sensor.
    - Instructional space - Lighting should be provided with dimming switches or step dimming (via inboard outboard switching of lamps). Switching or dimming of lamps or fixtures should allow manual control of lighting levels to allow for video viewing including switching fixtures "off" near the viewing screen location. Light fixtures shall be controlled by occupancy sensors with line voltage override switches to allow for manual off override capabilities.
    - Gymnasiums/Commons/Large Gathering Areas – Key-type switches can be used at the discretion of the district to control lighting relays in these areas (on and off); astronomical clock shall provide automatic "off".
    - Locker rooms shall use occupancy sensors.
    - Corridors – Occupancy sensors shall be used to control the lights. Key type switches shall be provided to allow for "off" override capabilities.
    - Restrooms - Occupancy sensors shall be used to control lights.
    - Offices - Light fixtures shall be controlled by occupancy sensors with line voltage override switches to allow for manual "off" override capabilities.
    - Other rooms such as storage rooms, janitor rooms, or other spaces with infrequent occupancies shall have light fixtures controlled by occupancy sensors. Mechanical and electrical room light fixtures shall be controlled manually.
    - Provide elevator room and elevator pit lighting and power in compliance with article 620 of the NEC.
- The design engineer shall participate in the day lighting study as stated in the Doors/Windows section under "Design Standards".
- Occupancy sensors shall be selected with appropriate technologies (ultrasonic/infrared/etc...) to mitigate false "off" suitable for the space. (i.e. small storage rooms will not require dual technology sensors where restrooms may.)

e. Exterior Lighting

See the Site Guidelines section for additional requirements.

- Exterior lighting shall be controlled by an astronomical time clock to comply with ASHRAE 90.1.
- Exterior lights shall be circuited to allow for turning "off" of selected lights not necessary for security purposes.
- Exterior lights that remain on after hours shall be "dark sky" compliant.

f. Fire Alarm Standards

- Fire alarm systems shall be of the addressable type.
- Main control panels shall be located in the administrative area with remote annunciator stations at the main entries, conforming to local jurisdiction requirements.
- The fire alarm system shall monitor and supervise tamper, flow, and post indicator valves of the building's fire suppression system.
- Visual devices shall be located in spaces occupied by students, instructors, and the public. Audible devices shall be located so the device delivers sounds levels that are 15 Db over ambient noise levels in areas occupied by students, instructors, or public.
- Provide audible alarm devices in high ambient noise areas such as technology production labs, vocal rooms, and instrumental rooms.
- Protect fire alarm devices located in gymnasiums, auxiliary gymnasiums, and locker rooms with wire guards.
- Fire alarm wiring shall be in conduit in concealed spaces to the accessible ceiling space at which point it can be routed in a cable tray or using cable hangers.
- Provide a fire alarm system riser diagram.

g. Lightning Protection Standards

- Within the design of the base building electrical system, the electrical design professional has the option of including an Underwriter’s Laboratory (UL) listed and certified lightning protection system, where calculations indicate the facility may be at elevated risk. Therefore, where calculations indicate the facility may be at an elevated risk, new school buildings shall be protected but additions to existing schools with no history of damage with similar roof elevations may be omitted.

h. Other

See the Technology/Special Systems section for additional and related electrical design information.

- O & M Manuals shall be provided in duplicate for the school district. Manuals shall contain approved shop drawings, operations and maintenance instructions and parts manuals for all electrical equipment.

- The contractor shall provide as-built mark up plans to the design engineer for transferring to electronic AutoCAD files. Provide the school district with two sets of CD's with AutoCAD files and PDF's of all electrical plans. Provide individual PDF files for each drawing. Mark each plan with "RECORD DRAWING" and indicate the date drawings were produced.

Table 2 - Recommended School Lighting Levels		
ROOM TYPE CLASSIFICATION	**RECOMMENDED DESIGN FOOTCANDLES DIRECT LIGHTING**	**RECOMMENDED DESIGN FOOTCANDLES INDIRECT LIGHTING**
ADMINISTRATIVE		
Offices/Receptionist	50	40
Storage Rooms	25	25
Restrooms	25-30	25-30
Conference/Resource Rooms	50	40
Health Clinic	50	40
Teacher Prep/Workroom	50	40
CLASSROOMS-GENERAL	50	40
Art Rooms/Kiln	50	40
Modular Technology Labs	50	40
CADD Labs	30	30
Industrial Tech/Production Labs	60	60
Computer Labs	40	40
Graphics Labs	50	40
Life Skills Labs	50	50
Science Labs	50	50
Laundry Rooms	25	25
Music Rooms	50	40
Large Group Instruction Rooms	50	40
MEDIA CENTER	50	40
Active Areas	50	40
Inactive Areas	40	40
ATHLETIC AREAS		
Gymnasium - Elementary School	75	60
Gymnasium - Middle School	75	60
Gymnasium - High School	100	60
Multi-use P.E. Rooms	50	10
Locker Rooms	25	25
STUDENT DINING		
Assembly	20	20
Stage/Work Lights	20	-
Make-up/Dressing Rooms	50	-
Theatrical Control Room	30	-

Technology/Special Systems

1. General

The following section provides guidance for developing a high quality technology system that balances flexibility, long life, and system costs.

The technology/special systems plans and specifications shall be prepared in accordance with the latest edition of the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual (TDMM). The plans should be designed and approved by a Registered Communications Distribution Designer (RCDD).

All work should be performed in accordance with the latest versions of the following construction standards and codes:

- International Building Code (IBC)
- Local Building Code
- Local Electrical Code
- National Electrical Code
- EIA/TIA-568 Commercial Building Wiring Standards
- EIA/TIA-569 Commercial Building Standards for Telecommunication Pathway and Spaces
- EIA/TIA-607 Commercial Building Grounding/Bonding Requirements Standard

a. Definitions

i. Trunk Lines

- Transmit voice and data in formats such as analog, T1, E1, ISDN, or PRI.

ii. Main Cross Connect (MCC)

- The point where the backbones and horizontal distribution facilities intersect. It can be thought of as the hub of cabling infrastructure for the facility. Note that many people refer to cross-connects by their older, nonstandard names: "distribution frames" (with the various hierarchies called MDFs, IDFs, and wiring closets).

iii. Intermediate Cross-Connect (ICC)

- The connection point between a backbone cable that extends from the main cross-connect (first-level backbone) and the backbone cable from the horizontal cross-connect (second-level backbone).

iv. Horizontal cross-connect (HCC)

- A closet where the horizontal cabling connects to a patch panel, which is connected by backbone cabling to the MCC.

v. ***Demarcation Point (DEMARC)***

- The interface point between customer-premises equipment and external network service provider equipment.

vi. ***Horizontal Cabling***

- The cabling between and including the telecommunications outlet and the horizontal cross-connect.

vii. ***UTP***

- An abbreviation that refers to cabling consisting of unshielded twisted pairs of conductors.

viii. ***Backbone Cabling***

- The inter-building and intra-building cable connections in structured cabling between entrance facilities, equipment rooms, and telecommunications closets. Backbone cabling consists of the transmission media, main, and intermediate cross-connects and terminations at these locations.

ix. ***Telecommunications Room (TR)***

- A local special systems equipment room.

x. ***Voice over Internet Protocol (VoIP)***

- A general term for a family of transmission technologies for delivery of voice communications over IP networks such as the Internet.

xi. ***Wide Area Network (WAN)***

- A computer network that covers a broad area. The largest and most well-known example of a WAN is the Internet.

2. Standards

a. Grounding

- Provide telecommunications grounding/bonding system in accordance with NEC-250 and TIA/EIA-607 using approved grounding hardware.
- As a minimum, provide a main telecommunications grounding bar at the special systems backboard and bond it to the following:
    - Grounding Electrode System – connect to grounding bar at the service entrance disconnect
    - Connect all remote telecommunication grounding bars to the main telecommunications grounding bar
    - Associated telecommunications cable tray(s)
    - Telecommunications conduit(s) entering telecommunications rooms
- As a minimum, the technology contractor shall provide telecommunications grounding/bonding for the following:

- Telephone system
- Equipment racks and cabinets
- CATV equipment
- Lightning and surge protectors
- Telecommunications devices
- Backbone cable shields
- Telecommunication and fiber cable shields
- Antenna cable shields
- Raised floors
- Cable trays

b. Raceway, Wiring, and Outlets

i. Raceway

- Provide telecommunications center-hung cable trays with 50 percent spare capacity above the corridor ceilings of academic wings.
- Cable trays shall connect all telecommunication/data rooms.
- Provide cable hanging devices such as "J" hooks to route cables from cable trays to end devices with no more than 4 feet spacing between hanging devices.
- Use conduit where cables are to be installed in concealed areas.
- Junction boxes used for data/voice/video outlets shall be a minimum 2-gang, 3 ½ inches deep boxes and equipped with a minimum of a 1 inch conduit home run to accessible ceiling space.
- Provide a minimum of 1 each 4 inch conduit for wide area network (WAN), cable television (CATV), and telephone from the service provider entrance (DEMARC) to the property line. Exact requirements should be coordinated with the local service provider engineer.
- Provide a minimum of 2, 4 inch conduits from the service provider entrance (DEMARC) to the main cross-connect (MCC) telecommunications room (TR).
- Conduit runs for fiber optic cable shall have no more than four 90 degree bends without installations of a pull box. All 90 degree bends are to be wide sweep.
- Provide at least 1 conduit sleeve with bushings and with 50 percent spare capacity in all classroom block walls to the corridor to allow for routing of technology wiring.

ii. Wiring

- The minimum standard for horizontal distribution wiring is category 6a or higher adopted under TIA standards, 4-pair, 24-gauge unshielded twisted pair (UTP) wiring.
- The maximum UTP cable length must not exceed 295 feet as specified in the EIA/TIA-568 commercial building wiring standard.
- Cat-6a cables or higher must be a continuous run and not spliced.
- Intra- and inter-building backbone wiring should be 62.5/125 micron graded-index multimode optical fiber cable. A minimum of 6 fiber strand cable should be installed for each cable run.
- Signal cables (i.e. sound and vision) should not be run parallel to the main power supply cables; this is especially important for microphone cables.

iii. Outlets

- Outlets shall consist of high-quality category 6a or higher RJ45 modular jacks with IDC-style or 110-style wire T568A or B terminations. Termination consistency must be maintained throughout the facility. Jacks must meet EIA/TIA-568 recommendations for category 6a or higher connecting hardware.
- Each classroom and office shall have at least two data/phone outlets. Consideration should be given to placing at least 1 data/phone outlet on each wall.
- A duplex power outlet with a ground shall be in close proximity to all data outlets.
- Flush mounted outlets should be used whenever possible. Surface mounted outlets should only be used in unoccupied areas such as electrical, mechanical, or storage rooms or on surfaces where construction does not allow for installation of flush mounted outlets.
- Surface mounted raceway systems with separate channels for power and low voltage wiring should be considered for areas with dense power and data/audio/video needs such as computer labs and broadcast rooms.
- Surface mounted equipment such as clocks, speakers, fire alarm devices and outlets located in gymnasiums or outdoors should be equipped with a wire guard or other protective housing to protect the device from damage.
- Phone and data jacks and their associated wiring shall be color coded so that they may be easily distinguished from one another. Other jacks and wiring specific to a technology system shall also be color coded by function. Wiring should terminate on dedicated panels for phone, data, and other technology systems. Labeling should be provided by the system at the patch panel.

c. Telecommunication Rooms

- Telecommunications/data rooms shall be provided with a minimum of 2 dedicated 120-volt circuits for powering rack mounted UPS units. If the building has a standby generator, these circuits shall be attached to the standby power.
- The telecommunications room housing the MCC should be located in a central area within the building.
- Air conditioning in TRs shall maintain temperatures in the range of 65 to 75 degrees.
- TR Floors shall be sealed concrete or tile; not carpet.
- The TR housing the MCC should contain at least 1 freestanding or wall mounted universal, 19 inch data rack.
- At minimum 20 percent spare rack space shall be provided in each TR.
- Adequate working space shall be provided to allow access to all data racks.
- Patch panels should be located in dedicated TRs, separate from mechanical, electrical, and other support spaces.
- If a non-standard dry type extinguishing system is requested by the district, refer to the mechanical design engineer and provide and coordinate a detection system that is also tied into the facility fire alarm system.

d. Intercom/Clock/Bell Systems

- Provide a complete intercom (intercom/clock/bell) communication system with call stations and speakers in each occupied space and speakers on the building exterior.
- The intercom system should be capable of generating various tone signals to be used in special notification situations.
- The intercom system should interface with the telephone system to allow for two-way communication between any location in the facility equipped with an intercom speaker and any location equipped with a telephone.
- In small rooms, a telephone handset with intercom capabilities should be considered as a substitute for an intercom station.
- Where a security system is installed, the intercom system should be interconnected to provide security alarm with supervision functionality. This will allow security stations to be armed and disarmed, individually and by zones, from any administrative telephone.
- Provide battery back-up for operation during a power failure.

e. Telephone System

- The telephone system shall provide voice over IP communications (VOIP) both internally and externally throughout the building and the district. District wide

(VOIP) communications should provide cost savings for inter-district telephone calls and allow direct dial capability to any phone within the District.

- Provide category 6a or higher, UTP cable to all telephone, fax, alarm, elevator, and ancillary voice connections.
- A telephone set is not required in each classroom; however, the necessary wiring infrastructure should be installed to provide access to the telephone system on an as-needed basis.
- Provide telephone jacks and telephones in classrooms, offices, media center, teacher prep areas, workrooms, conference rooms, secretarial areas, telecommunication rooms, elevators, etc..., as determined by the district's program needs.
- Provide a minimum of 1 speakerphone attendant console with multiple programmable function keys and one-touch button calling for all extensions within the building. The attendant console should be located in the main administrative reception area.
- Provide battery back-up for operation during a power failure.
- Provide personalized programming for each system within the district.
- Provide personalized training for all users within the district.
- The phone system shall be provided with emergency power to allow for full system operation for four hours upon loss of utility power.

f. Video Distribution System

- A video delivery system should include in all classrooms to allow distributing centrally-located RF video programming sources such as CATV, satellite dish programming, etc...
- At least 1 video distribution outlet should be located at the A/V cabinet or television location in every classroom.
- CATV cabling shall be shielded type.

g. Classroom Video System

- At least 1 surface mounted data outlet and 1 grounded duplex power outlet shall be placed in the central ceiling space of every classroom to support installation of a video projector.
- Where a projector will be installed, a projector A/V outlet shall be placed near the teacher's desk and a ventilated cabinet shall be provided for housing A/V equipment.
- If a projector will not be installed at the time of construction, provide a dual gang telecommunications outlet with a blank cover plate and a minimum 1.5 inch conduit to accessible ceiling space to support future projector A/V cable runs.

- In locations where a television will be installed, an outlet with data and video distribution ports should be located behind the television location. A grounded duplex power outlet should also be located behind the television.

h. Classroom Sound Field System

- A sound-field amplification system shall be provided in every classroom to increase student achievement and reduce teacher vocal strain. The sound-field amplification system shall be tied into the school intercom system allowing announcement override during lectures.
- The system shall include at minimum the following:
    - Two wireless microphones,1 each handheld and lapel microphone
    - Built in mixer, equalizer, and amplifier that is able to amplify sources such as a computer, DVD player, or TV tuner
    - Four or more overhead ceiling speakers
    - All necessary wiring, raceway, mounting hardware, connectors, adaptors, and equipment necessary for clean installation and system operation
    - Audio output with gain control for the assistive listening system conforming to the ADA guidelines
    - An interface to mute the system inputs when a page comes through the school intercom system

i. Sound Reinforcement System

- A separate sound system should be provided in assembly and performance event areas.
- The system should be designed for a high degree of intelligibility and a full range of stereo music capabilities.
- Provide easily accessible controls for adjusting sound levels.
- Provide a minimum of 2 combination microphone/auxiliary jacks. Provide separate wireless sound systems for both performers and for attendees requiring assistive listening. The assistive listening system shall conform to the ADA guidelines.
- Loudspeakers should provide a maximum 3 decibels difference in sound level across the entire seating area and 25 decibels over the highest ambient noise level.
- A feedback elimination system should be provided.
- A portable or permanently installed console/cabinet containing audio playback equipment, mic mixer, mic inputs, and associated audio cables for attaching to the permanently mounted microphone and auxiliary input faceplates should be

included. When equipped with an FM tuner, connect to an FM antenna mounted externally to the building.

j. Security System

(See the Safety and Security section for more information on security.)

- Provide the following minimum security system:
    - Exterior door control access via a proximity card access system or other security systems at all main exterior doors leading to interior spaces.
    - Interior door control access to allow for separation of classroom spaces from other "common" areas or activity areas (such as the gym) see safety and security section.
    - Door contact lock and position system at exterior doors, computer rooms, administration area, main electrical, mechanical rooms, and administrative suites.
    - Panic button system (in administrative area) to activate the electric door locks to lock down the school premises.
    - Window monitoring hardware should be considered.
    - A CCTV system with exterior cameras that view
        - the parking lot,
        - the school playground, and
        - the exterior doors.

      Additional cameras are considered an enhancement, paid for by the school district.

k. Interactive Electronic Classroom Whiteboard Rough-In

- Installation of an interactive whiteboard system should be considered in all classrooms. The whiteboard should included the following features at a minimum:
    - Automated recording and sharing of whiteboard notes
    - Bluetooth and/or USB connectivity to a classroom computer
    - The electronic whiteboard should be capable of interfacing with the classroom projector system at the whiteboard
    - If an interactive whiteboard is not installed in classrooms. Telecommunications raceway and a power outlet should be provided at all classroom whiteboards to accommodate future installation
- Some interactive whiteboard systems (such as the Luidia eBeam (as of 2009)) are compatible with existing whiteboards and utilize Bluetooth communication between devices. This type of system should be considered for use in existing rooms where standard whiteboards are installed.

- The wall on which the white board is located should be able to hold whatever future technology may be mounted on them.

l. Other

- O & M manuals shall be provided in duplicate for the school district. Manuals shall contain approved shop drawings, operations, and maintenance instructions and parts manuals for all electrical equipment.
- The contractor shall provide as-built mark up plans to the design engineer for transferring to electronic AutoCAD files. Provide the School District with two sets of CD's with AutoCAD files and PDF's of all electrical plans. Provide individual PDF files for each drawing. Mark each plan with "RECORD DRAWING" and indicate the date drawings were produced.

Specialties

1. Types of Specialties

Types of specialty items include:

- Visual display boards
- Fire extinguishers
- Wire mesh partitions
- Lockers
- Toilet compartments

2. Construction Standards

a. Visual Display Boards, Fire Extinguishers, and Wire Mesh Partitions

i. Chalkboards

- 0.021 inch thick porcelain enamel steel face sheet with matt finish
- 3/8 inch particleboard core
- 0.005 inch aluminum foil backing
- Anodized extruded aluminum trim

ii. Marker Boards

- Porcelain enamel face sheet with high gloss finish
- 3/8 inch particleboard core
- 0.005 inch aluminum foil backing
- Anodized extruded aluminum trim

iii. Tack Boards

- Factory built, vinyl covered, 3/8 inch industrial grade fiberboard core material or Vinyl impregnated cork (natural or colors)
- Anodized extruded aluminum trim

iv. Fire Extinguishers

- Must comply with NFPA and ADA guidelines with the type and size selected for use in specific areas

v. Wire Mesh Partitions

- Cold-rolled steel C-section channels for vertical members and steel channels for horizontal frame
- Ten gauge steel wire woven into 1-1/2 inch diamond mesh

b. Lockers and Toilet Compartments

i. General Lockers

- Must comply with ADA guidelines
- Form body from steel sheet
- Assemble locker units by bolting together
- Steel frames and doors
- Recessed handle and latch
- Baked enamel finish
- Provide ADA lockers

ii. Athletic Lockers (Punched Type)

- 20 gauge sheet steel with diamond shaped perforations for sides
- 20 gauge perforated steel doors
- Baked enamel finish

iii. Athletic Lockers (Expanded Metal Type)

- 0.0897 inch expanded metal backs, sides and doors
- Backed enamel finish
- Provide ADA lockers

iv. Metal Toilet Compartments and Urinal Screens

- Zinc coated steel sheet ASTM A591, Class C consisting of 18 gauge overhead braced pilasters
- 20 gauge partition panels with a sound deadening core
- 22 gauge doors with stainless steel door hardware
- Electrostatic and baked enamel paint finish; and polished anodized aluminum rails and mounting brackets
- Consider stainless steel finish only in high humidity areas where a corrosive environment exists

v. Solid Plastic Toilet Compartments

- Solid high density polyethylene (HDPE), polypropylene (PP) or solid phenolic core construction not less than 1 inch thick
- Recycled content of HDPE to be in range of 20 to 35 percent

3. Guidelines

- Sturdy, well constructed
- Maintenance free
- Able to easily replace damaged components

- Choose quality manufacturers
- Wide range of color selections
- Durable, sanitary, easy-to-clean finishes
- Ceiling attachment for toilet partitions
- Use recycled/recyclable material if available
- Consider use of materials and products provided locally, within 500 miles of project

Fixed Equipment

The K-12 school environment requires special needs for fixed equipment. These items must be strong and sturdy to last many decades. Manufacturers must specialize in these areas to meet the broad age range of students. Safety of these products is essential, and they must meet construction standards, codes, and ADA guidelines.

1. Types of Fixed Equipment

Types of fixed equipment include:

- Theater fixed equipment
- Stage fixed equipment
- Athletic fixed equipment
- Projection screens
- Casework
- Bleachers

a. Theater, Stage, and Athletic Fixed Equipment, and Projection Screens

i. Guidelines

- Material: woven velour fabric.
- Fabrics shall be flame resistant.
- Curtain tracks as recommended by the manufacturer.
- Stage rigging and fire curtain systems shall meet all fire and life-safety codes and OSHA safety requirements.

ii. Construction Standards

- Theater-electric operated projection screen: 3 position control switch with metal device box for flush wall mounting and for connection to 120v, AC power supply; screen same as manual screen.
- Manual, front projection screen: matte white, vinyl coated glass fiber fabric complying with FSGG-5-00172D for Type A screen surface; 80 inches by 60 inches in classrooms.
- Athletic equipment to comply with National Federation of State High School Associations.
- Basketball backboards: 72 inch by 42 inch, ½ inch thick transparent, tempered glass.
- Wall-mounted safety pads: 14 ounce PVC coated polyester or nylon reinforced PVC fabric; pad cover over 2 inches, 6 pound density polyurethane over composite panel.

b. Casework and Bleachers

With casework, environmentally preferable product alternates shall be utilized, such as oriented strand board (OSB), high density particle board, and recycled plastic. Equipment and furnishings must be as maintenance-free as possible and easily cleaned.

i. Guidelines

- Recycled/recyclable
- Formaldehyde free
- Local materials (within 500 miles)
- Low VOC

ii. Construction Standards

- Casework shall conform to ADA guidelines and state and local regulations.
- Countertops shall not deflect more than ¼ inch when a 100 pounds per foot load is applied.
- Shelving shall be capable of supporting 25 pounds per square foot.
- Countertops shall be 0.048 inch thick plastic laminate conforming to NEAM HG5.
- Exposed surfaces shall be 0.028 inches thick plastic laminate conforming to NEAM NG5.
- Hardware: conform to ADA guidelines; standard finish, commercial quality, heavy duty.
- Provide a 5 year warranty on casework.
- Lab casework: solid wood and plain sliced veneer plywood, or high pressure plastic laminate NEMA LD3.
- Countertops: 1 inch thick, epoxy resin and cast epoxy resin sinks.
- Locks: cylinder type, 5 disk tumbler mechanism.
- Hinges: 5 knuckle with hospital tips, 0.090 inch steel, 270 degree swing complying with BHMA 156.9, Grade 1.
- Telescoping bleachers shall comply with NFPA 102, Chapter 5, “Folding and Telescopic Seating”.
- Provide a 5 year warranty for bleachers.

Table 3 - Casework Lineal Footages per School Type and Space									
Space	**Elementary**			**Middle**			**High**		
	Base	Wall	Notes	Base	Wall	Notes	Base	Wall	Notes
General Classroom	18 LF	24 LF	1-3, 27	18 LF	24 LF	1-3, 27	18 LF	24 LF	1-3, 27
Science				68 LF	28 LF	2, 8, 9, 12	24 LF	48 LF	2, 9-11
Science Prep				23 LF	23 LF	4	23 LF	23 LF	4
Special Education	18 LF	18 LF	2,4,5	18 LF	18 LF	2,4,5	18 LF	18 LF	2,4,5
Music	18 LF	18 LF	6	18 LF	18LF	6	18 LF	18 LF	7
Art	77 LF	42 LF	2, 3, 15	77 LF	42 LF	2, 3, 15	77 LF	42 LF	2, 17
Computer Lab		18 LF	2,13		18 LF	2,13	34 LF	18 LF	2,13
Media Center/Library	33 LF	25 LF	19-22	33 LF	25 LF	19-22	35 LF	20 LF	23-26
Gymnasium/Physical Education									
Multipurpose									
Kitchen			18			18			18
Stage/Auditorium									
Vocational Education									18

Notes:

1. Learning Wall with Book Storage – 20 LF
2. Lockable Teacher Cabinet – 3 LF
3. Low Book Shelves – 36 LF
4. Tall Storage Cabinet – 12 LF
5. Computer Counter – 20 LF
6. Instrument Storage Cabinet – 28 LF
7. Instrument Storage Cabinet – 36 LF
8. (6-7) 3'x6' Lab Tables
9. Science Lab Demo Table – 8 LF
10. Science Lab Counter – 95 LF
11. Computer Counter – 16 LF
12. Computer Counter – 8 LF
13. Computer Counter – 105 LF
14. Computer Counter – 75 LF15. (6) 3' x 6' Art Tables
15. (6) 3' x 6' Art Tables
16. Tall Storage Cabinet – 40 LF
17. (8) 3' x 5' Art Tables
18. See sample floor plans for various equipment pieces and their respective casework
19. Tall Book Stacks – 167 LF
20. Computer Counter – 21 LF
21. Tall Storage Cabinet – 45 LF
22. Reception/Check-Out Desk – 24 LF
23. Tall Book Stacks – 212 LF
24. Computer Counter – 30 LF
25. Tall Storage Cabinet – 57 LF
26. Reception/Check-Out Desk – 34 LF
27. Computer Counter – 6 LF

Safety and Security

Safety and security of a school and its property should be a top priority at the inception of a site selection. Such issues as busy streets and neighborhoods should be thought about during the site selection process. Once a site is selected, the design team should continue considering all aspects of safety and security not only for the safety of the property but also for the safety and security of the school's students and staff.

The following section addresses safety and security issues around the exterior of a school and its site and throughout the interior of the school. For more on safe schools, see the Safe Schools page at the National Clearinghouse for Educational Facilities website, www.ncef.org.

1. Types of Safety and Security Controls

There are four main types of safety and security controls: detection, notification, response, and prevention. First and foremost, every effort should be taken to prevent a hindrance to the safety and security of a school's students, staff, building(s), and site. If there is a breach to the safety and security of a school, the site, and its occupants, systems should be in place to detect the breech, notify responders to the breech, and respond to the breech.

2. Guidelines

In addition to the guidelines listed below, each school in every District will have written policies describing an emergency plan and written policies for school security.

a. Exterior Site Control

Access to the site should have various controls in place to eliminate or mitigate safety and security issues.

- Be conscience of where trees and shrubs are placed. Both can impede on site lines in parking lots and around the school site. Also, trees that are tall growers such as elm, oak, etc..., if planted next to a building, can allow a route to the roof, second stories, or windows when they reach maturity. For the safety and the security of a school, do not plant these types of trees next to a building.
- Jogs in a building's exterior can create hiding places or blind spots for those supervising the school; eliminate these types of areas when possible.
- Review a "dark sky" approach to site lighting vs. a heavily lit site and explain the pros and cons of each to the district. If a "dark sky" approach is taken, use motion detectors to turn on exterior lights if someone comes onto the property.
- Provide sidewalks to the school from surrounding neighborhoods/subdivisions across school property. This will allow a safe route to the school.
- Provide crosswalks across streets where students will be traveling.

- Use traffic controls or calming devices to reduce the speed of cars through large parking lots and long drive aisles.
- Construct the bus loop in a separate location from the parent drop off. Staff parking can be included within the bus loop. See the Site Guidelines section for further information.
- Place handicap parking close to the main entrance of the school and when possible; do not require people parking in these spaces to have to cross a lane of traffic.
- Do not require busses to back up when pulling into the bus loop to drop off/pick up students.
- Make sure play areas have a defined border and are separated from vehicle traffic.
- Provide a soft fall surface under all playground equipment. This surface should extend six feet in all directions from the equipment and be ADA accessible.
- Exterior lighting should be vandal resistant and 12 to 14 feet high.
- Eliminate blind spots around the building exterior.
- Fence or pipe all open irrigation ditches, canals, or drains.

b. Exterior Access Control

Every effort should be made to control the access to the school and its site.

- Provide a prominent main entrance to a school to allow visitors, new staff, new students, first responders, etc... to quickly identify the main entrance.
- When necessary, provide bollards at the main entrance walkway to eliminate people from driving up to the main entrance of a school. This should also be considered for other entrances around the school that are easily accessible by a vehicle.
- Provide a key card or other digital device to allow teachers and staff access into the school other than keys. This will allow the district to see who is entering/exiting a building and at what time.
- Provide indicators that show when main exterior doors are open, shut, and locked.
- The SFC will fund cameras located at the front entrance that look out to the parking lot(s), parent drop-off, bus drop-off and cameras showing the playground (4 to 6 cameras) any additional cameras are an enhancement paid for by the District (refer to the Technology/Special Systems section).
- Provide signs and fencing to clearly define the property and its entry/exit areas. A 6 foot chain link fence is recommended around the entire developed play/recreational site.

- Provide a view from the administration area into the visitor parking area to allow staff to see who is entering the school.
- Provide lockable enclosures for all exterior and roof mechanical equipment enclosures.
- Limit the number of exterior doors.
- Make sure that covered walkways, canopies, posts, walls, planters, etc... don't allow access to roofs, second stories, or windows.

c. Interior Circulation and Access Control

Just as the site and the exterior access of the school has controls in place to eliminate or mitigate safety and security issues, the interior of the school should have similar controls in place (this does not require the use of key cards on the interior of the school).

- Design the main entrance of the school so that visitors must check in with the office before entering the school. This can be accomplished by creating a security vestibule that is unlocked at the exterior doors and locked at the interior doors. Visitors would then have to check in with the receptionist or administration before being allowed into the school
- Provide a line of site from the main administration area to the visitor parking lot. This will allow administrators the ability to see who is entering and exiting the school.
- Use occupancy sensors on the lights within the school to allow lights to turn on if someone enters the school after hours.
- Allow the ability of the classroom wings to be secured for after hour use. Place all after hours use spaces (auditoriums, gyms, media centers, etc...) in an area together so that they can be open to the public for after hours use and the rest of the school can be secured. Security doors should be held-open with magnetic locks that can be closed with a central switch to lock off the classroom spaces
- Provide two-way communication between all classrooms and the administration area for safety purposes.
- Provide back-up generators into school designs where power outages are common. Back-up generators will only provide power for emergency systems: PA system, critical servers, telephone, and fire alarm. A power reliability analysis is required to justify the need for a generator. (See the Electrical Systems section for more information.)
- All windows that open need to be lockable.
- Provide at least one cupboard/closet in each classroom with a lock for the teacher's personal possessions.
- Provide a lockable cupboard/closet in the nurse's office to store drugs.

- Provide a window into the nurse's room to allow for additional supervision of students by office staff.
- Provide a lockable cupboard/closet in the science classrooms to store hazardous chemicals.
- Provide a gas shut off switch at the teacher's lab station in all science rooms.
- Provide a secondary exit out of the principal's office; this can be accomplished through a conference room, etc...
- Mount display cases, water coolers, etc... flush to the wall to eliminate a safety issue.
- Be conscientious of where basketball backboards are placed in gymnasiums and multipurpose rooms. Provide padding on walls close to backboards, and do not place doors directly behind backboards.
- Have doors to individual toilet rooms swing outward to eliminate the possibility of someone becoming trapped if they were to fall in front of the door.
- Provide hard lid ceilings in all restrooms.
- Locate electrical outlets in the wall when possible; avoid the use of floor outlets.
- Provide non-flammable or fire-retardant stage draperies/curtains.
- Provide a view window from the coach's/P.E. teacher's office into the locker room for surveillance.
- If motion sensors are not used, provide key-locked light switches in restrooms and corridors to prevent tampering.
- Provide a panic button at the receptionist's desk in case of an intruder.
- Eliminate blind spots throughout the interior of the building.
- Consider providing the front office with a windowless space or "safe room" with a lockable door and a telephone for emergencies."
- Prepare security lockdown strategies.
- Provide view panels in classroom doors.
- Provide one window in each room for emergency rescue.
- Provide shatterproof mirrors in restrooms and classrooms.
- Provide an accent color in the floor finish for each classroom door to assist the visually impaired.
- Provide an accent color at the classroom door alcoves, water coolers, exit doors, stairs, and restrooms for visually impaired in the corridors.

Specialty Spaces

1. Kitchens

Food service criteria varies greatly from district to district. Therefore, kitchen spaces are highly variable in space and equipment requirements. The two types of kitchens are preparation (prep) kitchens and warming (serving) kitchens. Districts, for many reasons, may have a need for hybrid kitchens. Any kitchen design varying from either a typical preparation kitchen or a typical warming kitchen must receive early review and approval from a SFC representative. (Note: These guidelines do not apply to district-wide distribution kitchens. Those types of kitchens will be reviewed on a case-by-case basis.)

a. Preparation Kitchens

The kitchen area consists of the following areas:

- Preparation/production area
- Serving area
- Dry food storage
- Cooler/freezer
- Ware washing
- Office area for planning and ordering
- Restroom
- Lockers (optional but recommended)
- Janitorial closet (optional but recommended)
- Floor drains

The size of the preparation kitchen for planning purposes will be a minimum of 1250 square feet up to 250 meals served and will increase by 2.5 square feet per meal served above 250 meals served.

The kitchen should have the following spatial relationships:

- Adjacent to student dining
- Near staff dining
- Near table storage
- Adjacent to loading/receiving area
- Access to solid waste disposal

b. Warming Kitchens

The kitchen area consists of the following areas:

- Production area

- Serving area
- Storage
- Ware washing
- Receiving
- Office area for planning and ordering
- Restroom
- Lockers (optional but recommended)
- Janitorial closet (optional but recommended)
- Floor drains

The size of the warming kitchen for planning purposes will be a minimum of 500 square feet up to 250 meals served and will increase by 1 square feet per meal served above 250 meals served.

The kitchen should have the following spatial relationships:

- Adjacent to student dining
- Near staff dining
- Near table storage
- Adjacent to loading/receiving area to receive transported food from a central kitchen
- Access to solid waste disposal

Some of the key elements in any efficient kitchen layout are:

- Separate lockable dry food storage area
- Combined walk-in cooler and freezer
- Separate staff toilet with 8 half height lockers
- Office area for planning and ordering
- Dish return area separated from cooking or serving lines
- Oversized serving door (42" minimum)
- Waste discharge away from the cooking prep area
- Provide a mop sink nearby
- Verify with the code official if a second exit is required

2. Stages and Equipment

Most modern schools will provide an area for speakers, presentations, performances, and celebrations. These areas can be as simple as a stage space in the multipurpose, commons, or cafeteria, or as complex as an auditorium with full stage lighting and sound system. (Note: These guidelines do not address auditoriums. Auditoriums are only in large high schools and will be reviewed on a case-by-case basis).

a. Elementary School

For elementary schools, a stage or raised platform is adequate. This space is often a dual use space, also used for other functions in the school such as a music room, classroom, or additional dining area. If used for other functions, increase the space to provide storage and teacher space. The space should be slightly raised and be ADA accessible.

The stage space should include the following features and equipment:

- Lighting – fixed and moveable (one light bar is adequate)
- Projection screen
- Front curtain and valence
- Operable partition (if used as a classroom space)
- Sound enhancement system (include with dining or multipurpose space)
- Video ports and data ports
- Instrument storage (if used as a classroom space)
- Chair storage

b. Middle School

The middle school stage or performance area should provide an area more suitable for assembly type programs, performances, and presentations for students and adults than found in elementary schools. The stage should be adjacent to and included in the student dining, multipurpose area, or commons area. The space should be slightly raised and be ADA accessible. The space should be adjacent to the music room(s).

The stage space should include the following features and equipment:

- Dimmable lighting – fixed and moveable (one light bar is adequate)
- Lighting control console and DMX input and output receptacles for a FF&E modular theatrical dimming system (see the FF&E Guidelines in Appendix D)
- Projection screen
- Front curtain and valence
- Rear curtain
- Border curtains

- Operable partition (if used as a classroom space)
- Sound enhancement system
- Sound control console receptacle
- Video ports and data ports
- Instrument storage (if used as a classroom space)
- Chair storage

c. High School

The high school stage or performance area should provide an area more suitable for stage acting and musical performances in addition to assembly type programs, performances, and presentations for students and adults than found in elementary or middle schools. If the high school is using a stage rather than an auditorium, the stage should be adjacent to and included in the student dining, multipurpose area, or commons area. The space should be raised and be ADA accessible. The walls and structure should be designed for auditorium-type acoustics, sound system, and lighting. The space should be adjacent to the music room(s).

The stage space should include the following features and equipment:

- Dimmable lighting – fixed and moveable (two light bars are adequate)
- Lighting control console and DMX input and output receptacles for a FF&E modular theatrical dimming system (see the FF&E Guidelines in Appendix D)
- Projection screen
- Front curtain and valence
- Rear curtain with track
- Border curtains
- Mid stage traveler
- Sound enhancement system
- Sound control console receptacle
- Video ports and data ports
- Chair storage

Some of the key elements in stage layouts are:

- Locate the music room behind the stage for convenience of moving to and from the stage for performances
- The music room shall contain spaces for a large practice room, small practice room, office, and storage room for music and instruments

- Commons to accommodate the lunch program based on the education specifications
- Consider acoustical treatment in the Commons
- The adjacencies are important to the function of the space

3. Physical Education Spaces (Gyms/Multipurpose Rooms)

d. Elementary School Multipurpose Rooms

The physical education (P.E.) space should be adequate to allow students to practice and participate in exercise, sports activities, intramural games, and physical fitness. The space can also be used for student assemblies and community use. The space should have direct access to outdoor play/activity areas and should provide storage for P.E. equipment. Review Table 1 - Interior Floor Finishes table (in the Interior Floor Finishes section) for a list of acceptable flooring. (Note: Wood flooring is not an acceptable floor finish for elementary schools; in elementary schools wood flooring is considered an enhancement.) Fixed equipment will include safety wall wainscot and fiber glass basketball backstops with adjustable height. Provide court markings for the appropriate sized basketball court and an 18 foot clear ceiling height maximum.

For elementary schools, telescoping bleachers or stands are considered an enhancement and will be funded by the district.

e. Middle School Gymnasiums

The P.E. space should be adequate to allow students to practice and participate in exercise, sports activities, intramural games, and physical fitness. The space can also be used for student assemblies and community use. The space should have direct access to outdoor play/activity areas. Storage should be provided for P.E. equipment. Twenty-two feet clear ceiling height is maximum.

Middle school P.E. spaces may include:

- Gymnasium
- P.E. office
- Staff shower
- Student locker rooms
- Student restroom/showers
- P.E. storage
- Appropriate athletic flooring (Review the Table 1 - Interior Floor Finishes in the Interior Floor Finishes section for a list of acceptable flooring)

Fixed equipment:

- Glass basketball backstops
- Volleyball sleeves and standards
- Safety wall wainscot
- Divider gym curtain
- Telescoping bleachers

Miscellaneous items:

- Court markings for an appropriate sized basketball court (74 feet by 42 feet)
- Regulation volleyball court
- Two cross courts

f. High School Gymnasiums

The P.E. space should be adequate to allow students to practice and participate in exercise, sports activities, intramural games, physical fitness, and interscholastic athletic competition. The space can also be used for student assemblies and community use. The space should have direct access to outdoor play/activity areas. Storage should be provided for P.E. equipment. Twenty-four feet clear ceiling height is maximum

High School P.E. spaces may include:

- Gymnasium
- Auxiliary gymnasium (as appropriate for design capacity)
- P.E. office
- Staff shower(s)
- Student locker rooms
- Student restroom/showers
- P.E. storage
- Training room
- Appropriate athletic flooring (Review the Interior Floor Finishes table in the Interior Floor Finishes section for a list of acceptable flooring)

Fixed equipment:

- Glass basketball backstops (six)
- Volleyball sleeves and standards
- Safety wall wainscot
- Divider gym curtain
- Telescoping bleachers

Miscellaneous items:

- Court markings for an appropriate sized basketball court (84 feet by 50 feet)
- Regulation volleyball court
- Two cross courts

4. Locker Rooms

a. Middle and High School

Locker rooms are provided to students as a place to change from their regular clothes into clothes appropriate for P.E. Locker rooms should provide a place for storage of personal belongings, restrooms, and shower facilities. The locker rooms should be adjacent to the P.E. space (gym, multipurpose room, etc…), adjacent to student restrooms/showers, adjacent to the P.E./athletic office(s), have direct access to outside playfields, and located on the gymnasium level. Locker rooms will be provided for both the boys and girls. Keep in mind that these locker rooms will likely be used after hours and by visiting sports teams.

Locker rooms may include:

- Athletic lockers
- Benches
- Exhaust air system
- Independent temperature control
- Moisture and stain resistant finishes

5. Science Rooms including Lab and Prep Areas

a. Middle School

The primary use of the science rooms will be science instruction and discovery activities. The laboratory can also be used for instruction and other hands-on experiences in other discipline areas. Place science rooms adjacent to at least one typical classroom that has resources for math instruction. In some instances, the lab space can be used as instruction space. Each room will also have an area for preparation of materials; often this space will be included in a smaller, adjacent room.

i. Construction Standards

- Teacher demonstration area
- Student work tables
- Sinks
- Emergency shower/eyewash with a drain
- Gas connections

- Master gas shutoff
- Adequate ventilation
- Materials storage

If chemical lab work is taught at the middle school level, a combined lecture/lab layout as shown is one option. This layout provides lab stations on two walls, a demonstration lab table at the front of the room, and a separate prep or storage room. Tables can be arranged in a typical classroom layout and then wheeled to the lab stations (as shown). (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

- Provide an eye wash and shower with a drain
- Provide lab stations for 24-26 students
- Provide acid resistant counter top if required by curriculum (limit to the demonstration station only)
- Provide a fume hood if required by curriculum
- Provide gas, power, and water at lab stations
- Provide an emergency shut off near instructor counter or desk area
- Provide dilution trap and drain if required by curriculum (limit to the demonstration station only)
- Verify with local health district if waste is to go to a separate holding area
- Verify with the code official if a second exit is required

b. High School

The primary use of the science rooms will be demonstrations, data collection and analysis, laboratory experiments, and large group, small group, and individual instruction. Place science rooms adjacent to other science classrooms and next to a science prep room. Prep rooms may be shared by two science rooms. In some instances, the lab space can be used as instruction space. Due to the types of materials and chemicals being used, these rooms will have higher than normal ventilation requirements. It will also be important to use moisture and stain resistant finishes and chemical resistant counter tops.

i. Construction Standards

- Teacher demonstration area
- Student work tables
- Computer work station
- Sinks
- Emergency shower/eyewash with a drain
- Gas connections

- Master gas shutoff
- Adequate ventilation
- Materials storage

Suggested elements for a high school science lab are: (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

- Provide an eye wash and shower
- Provide lab stations for 24-26 students
- Provide acid resistant counter top if required by curriculum
- Provide a fume hood if required by curriculum
- Provide gas, power, and water at lab stations
- Provide an emergency shut off near instructor counter or desk area
- Provide dilution trap and drain if required by curriculum
- Verify with local health district if waste is to go to a separate holding area
- Verify with the code official if a second exit is required

6. Media Centers

Media centers and libraries are ever-evolving spaces due to the advancement in technology. This space, in all schools, should be as flexible as possible to change with new advancements in technology. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

a. Elementary School

Media centers provide students access to information technology and multimedia materials while providing an area for individual, small group, and classroom research. Media centers/libraries should be easily accessible to all classroom wings and have easy access to public parking. Often, this space is used for after hours use by the community.

Media centers may include the following spaces:

- Reading room and circulation area
- Media specialist office
- Workroom and storage
- Computer lab (if a computer lab is required, place it adjacent to the media center)

i. Construction Standards

- Computer work stations
- Student tables
- Library book shelving

- Instructional space (white board, interactive board, etc…)

b. Middle School

Media centers provide students access to information technology and multimedia materials while providing an area for individual, small group, and classroom research. These areas should be inviting areas to allow for recreational reading, provide access to research, technology, storing, cataloging, and reproducing materials and information. Media centers should be easily accessible to all classroom wings and have easy access to public parking. Often, this space is used for after hours use by the community.

Media centers may include the following spaces:

- Reading room and circulation area
- Media specialist office
- Workroom and storage
- Computer lab (if a computer lab is required, place it adjacent to the media center)
- Document storage

i. Construction Standards

- Computer work stations
- Student tables
- Library book shelving
- Instructional space (white board, interactive board, etc…)
- Small study areas
- Student tables

Flexibility is essential to accommodate the rapidly changing technology. If the trend continues, more computer stations will be needed and less book storage will be required in the future. There is still need for a librarian office/work room with a sink, a main circulation desk, and a storage room. An adjacent computer lab will provide more flexibility for the future. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

c. High School

Media centers provide students access to information technology and multimedia materials while providing an area for individual, small group, and classroom research. These areas should be inviting areas to allow for recreational reading, provide access to research, technology, storing, cataloging, and reproducing materials and information. Media centers/libraries should be easily accessible to all classroom wings and have easy access to public parking. Often, this space is used for after hours use by the community.

Media centers may include the following spaces:

- Reading room and circulation area
- Media specialist office
- Workroom and storage
- Computer lab (if a computer lab is required, place it adjacent to the media center)
- Document storage

i. Construction Standards

- Computer work stations
- Student tables
- Library book shelving
- Instructional space (white board, interactive board, etc…)
- Small study areas
- Student tables

Just as noted on the elementary/middle school media center, the high school media center also needs to be flexible. A minimum of 6 research computer stations should be provided. North natural light is ideal. Reading areas should provide adequate daylight with no direct sunlight or glare. This space should be located adjacent to a computer lab with visual supervision from the circulation desk. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

7. Art Rooms

a. Elementary/Middle School

Not all elementary schools will have a separate room for art. Some schools will provide art on a rolling cart that will be moved from classroom to classroom. Commons, cafeterias, and science rooms can also be used for art spaces.

Those schools that have additional space for an art room should provide a space for students to work on 2D and 3D art projects including drawing, painting, computer graphics, sculpturing, model making, collage, and ceramics. The art room may be located near the classroom wings and have direct access to the outside. Daylight is ideal for art rooms, especially when provided by north-facing windows. Care should be taken when choosing finishes since art will create messes and require surfaces that can be easily cleaned (see the Interior Floor Finish Table in the Interior Floor Finishes section). When possible, place the art room adjacent to a computer lab to allow ease of integration with computer graphics. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

i. Construction Standards

- Student work tables
- Demonstration area
- Sink
- Instructional space
- Display areas
- Storage space
- Uniform and natural lighting

Schools that provide kilns should include:

- A room adjacent to the art room
- Heat resistant floor coverings
- Ventilation
- Temperature controlled exhaust
- Dry storage
- Damp storage

Provide work tables for drawing and painting. Two sinks are provided. Each sink should have clay traps. Adjacent rooms house prep materials and a kiln. Day lighting is essential for this room. North facing windows are recommended. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

- Group work tables instead of desks. These are more flexible for various mediums and group projects.
- Provide a dedicated sink "wash-up" area.
- Provide work sinks for projects that contain clay traps if pottery work is taught.
- If pottery is taught a separate kiln room should be provided with keyed access.
- Provide a teacher work area with a phone and file storage.
- Provide adequate storage for all teaching aids and materials.
- Provide a separate storage or prep area for material storage.
- Verify with the code official if a second exit is required.

b. High School

Art rooms should provide a space for students to work on 2D and 3D art projects including drawing, painting, computer graphics, sculpturing, model making, collage, and ceramics. The art room should be located near the classroom wings and have direct access to the outside. Daylight is ideal for art rooms, especially when provided by north-facing windows. Care should be taken when choosing

finishes since art will create messes and require surfaces that can be easily cleaned (see the Interior Floor Finish Table in the Interior Floor Finishes section). When possible, place the art room adjacent to a computer lab to allow ease of integration with computer graphics. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

i. Construction Standards

- Student work tables
- Demonstration area
- Sink
- Instructional space
- Display areas
- Storage space
- Uniform and natural lighting

Schools that provide kilns should include:

- A room adjacent to the art room
- Heat resistant floor coverings
- Ventilation
- Temperature controlled exhaust
- Dry storage
- Damp storage

The high school art room should be flexible to accommodate a variety of mediums and teaching styles. Stained or sealed concrete floors are recommended for ease of cleaning. A separated pottery area with sinks and a separate room for the kiln is provided. Day lighting is essential for this room. North facing windows are recommended. (See Table 3 – Casework Lineal Footages in the Fixed Equipment section for casework requirements.)

- Group work tables instead of desks. These are more flexible for various mediums and group projects.
- Provide a dedicated sink "wash-up" area.
- Provide work sinks for projects that contain clay traps if pottery work is taught.
- If pottery is taught a separate kiln room should be provided with keyed access.
- Provide a teacher work area with a phone and file storage.
- Provide adequate storage for all teaching aids and materials.
- Provide a separate storage or prep area for material storage.
- Verify with the code official if a second exit is required.

Appendix A

UA Spreadsheet

Appendix B

Energy Life Cycle Cost Analysis Work Plan

Appendix C

Design Construction Standards for Outdoor Athletic Facilities

Appendix D

FF&E List

Appendix E

Example Building Systems Life Cycle Cost Analysis's